A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

JANUARY, 1936.

GENERAL PHYSICS.

ADSORPTION.

1. Heats of Adsorption of Gases and Vapours upon Crystallogenetic Adsorbents. A. B. Lamb and E. N. Ohl. *Am. Chem. Soc., J.* 57. *pp.* 2154–2161, *Nov.*, 1935.—The heats of adsorption of a number of gases and vapours on dehydrated chabasite, thomsonite and brucite are measured at 0°. The molar heats of adsorption of such of these substances as are copiously adsorbed by these materials are in general somewhat larger than those previously observed on charcoal and silica gel but, like them, vary only slightly with the amount adsorbed and can be represented by the same empirical equation. The net heats of adsorption are also considerably greater than those previously observed with charcoal and this indicates that the adsorbate on these adsorbents is subjected on the average to a more intense adsorptive and compressive force than on charcoal. AUTHORS.

2. Theory of Adsorption. H. Bradley. *Faraday Soc., Trans.* 31, *pp.* 1652–1655, *Dec.*, 1935.—The author draws attention to his formula proposed more than 8 years ago, viz., $a = \alpha p^{T/273x}/(1 + \beta p^{T/273x})$, where T is the absolute temperature and x is an integer. This formula is identical with Miyamoto's [see Abstract 1882 (1935)] with the additional advantage that the value of the exponent n is given. The formula is now applied with a high degree of success to the following experimental results: Adsorptions of CO and A respectively on cocoanut charcoal, of N_2 on charcoal, of water vapour by cotton, of acetone, bromine and isoamyl alcohol, respectively, in water on blood charcoal, and of benzoic acid in benzene on blood charcoal. Tables of data are included. H. H. Ho.

3. Rate of Evaporation of Adsorbed Atoms and Molecules. J. K. Roberts. *Faraday Soc., Trans.* 31. *pp.* 1710–1713, *Dec.*, 1935.—A formula for the rate of evaporation of adsorbed atoms or molecules is obtained directly from simple kinetic considerations. It is consistent with the behaviour of adsorbed films of O and H atoms on W, and also with that of O_2 molecules adsorbed on isolated single W atoms left bare during the formation of the atomic O film. A vapour-pressure equation is also deduced. [See Abstract 4748 (1935).] AUTHOR.

4. Wood-Water Relationships. W. W. Barkas. *Phys. Soc., Proc.* 48. *pp.* 1–17, *Jan.* 1, 1936.—The method used to distinguish experimentally between the amount w_a of water held by molecular sorption, and that, w_c, held by capillary retention on finely ground flour of Sitka spruce wood consists in flooding the evacuated flour with an evacuated aqueous solution of sucrose and measuring the change in concentration of the solution with an interferometer. Since capillary retention requires for its manifestation free liquid surfaces in the interstices of the wood, it is claimed that, when the vacuum method here described is used, only true molecular sorption will cause a change in concentration of the solution. Since there are indications that a certain small amount of sucrose also is absorbed by the wood, it is impossible to arrive at the exact value of w_a, but a minimum possible value $w_a(\text{min.})$ is given which varies with the vapour pressure of the solution used, and amounts, on extrapolation to infinite dilution, to some 23 % of the dry weight of the wood. The difference between the total sorption W measured on the vapour-pressure isothermal and the values of $w_a(_{\text{min.}})$ here found is taken to represent the maximum possible value for w_e. The question of the sorption of sucrose is discussed, and the suggestion is made that the moisture-content hysteresis in w_a is smaller than that in W; thus a greater proportion of water is held by capillary forces on desorption than on adsorption. AUTHOR.

5. Adsorption. I. Traube. *Faraday Soc., Trans.* 31. *pp.* 1730–1739, *Dec.*, 1935.—Anthracene, naphthalene and diphenylamine added to aqueous solutions of octyl alcohol and caprylic acid adsorb not more than a few mg. per gm. adsorbent and the Langmuir theory is probably applicable. If they are added to water-soluble or insoluble organic substances in an emulsified state the emulsified substances are adsorbed to a high degree, there being possibly several thousand adsorbed layers even when no adsorption takes place for single molecules in clear solution, and washing with water only removes molecular particles. Gibbs' principle is not valid when there are colloidal particles in the adsorbate. There is a close relation between adsorption and flocculation. In most cases adsorption is accompanied by the formation of large flocculates produced by the linking of the absorbent particles through the adsorbed substances. Similar effects exist in other cases. Attention is drawn to the capacity and intensity factors in the adsorption energy and methods of determining the adsorption intensity are considered. P. H. B.

See also Abstracts **103, 107, 141, 246.**

ATOMIC AND MOLECULAR STRUCTURE.

6. Energy of Binding of Heavy Nuclei. W. M. Elsasser. *J. de Physique et le Radium*, 6. *pp.* 473–476, *Nov.*, 1935.—The energy of binding of heavy nuclei is examined assuming the nuclei to build up by the addition of pairs of neutrons or protons, the binding energy of the pairs being 10·4 eMV and 1·6 eMV respectively. When neutron and proton shells are completed the binding energy changes abruptly, but within a given shell it increases regularly. With unpaired nuclei, considerations show that the possible arrangements are limited and the binding energy of the unpaired particles is approximately constant. F. C. C.

7. Intranuclear Forces. E. Feenberg and J. K. Knipp. *Phys. Rev.* 48. *pp.* 906–912, *Dec.* 1, 1935.—Quantitative information on the nature of intranuclear forces is obtained by considering the H and He isotopes, using a Hamiltonian of the exchange type based on the neutron-proton model with interactions between all the particles. It is found that the forces between like particles are given by a potential with depth not greater than 30 mc^2 and with an effective radius of action which must be less than $2 \cdot 8 \times 10^{-13}$ cm. A more accurate determination of the constants based on assuming a close correlation of the three- and four-body problems with " equivalent " two-body problems gives the depth of the proton-neutron potential as 74 mc^2 and of the like-particle potentials as 26 mc^2, and a range of $2 \cdot 2 \times 10^{-13}$ cm. for the forces. It is shown that if the exchange operators multiplying the neutron-proton interaction potentials are assumed to be linear combinations of the Majorana and Heisenberg types, it is possible to explain the large scattering of neutrons on protons at low velocities, and that in the three- and four-body problems such an operator can, to a good approximation, be represented by an equivalent Majorana operator. N. M. B.

8. Interaction of Nuclear Particles. L. A. Young. *Phys. Rev.* 48. *pp.* 913–915, *Dec.* 1, 1935.—Simple approximate calculations of the ranges and strengths of the interactions of nuclear particles lead to the following conclusions: The interactions are of an exchange nature with the range approximately $2\cdot8 \times 10^{-13}$ cm. The neutron-neutron and proton-proton interactions are approximately equal. The neutron-proton interaction probably depends upon spin orientation. For parallel spins the order of magnitude of the interaction is 40 mc^2, for anti-parallel spins 25 mc^2. It is further concluded that a di-neutron or di-proton may be dynamically stable, but unstable with respect to β-decay. AUTHOR.

9. Forces Governing Nuclear Structure. C. F. v. Weizsäcker. *Zeits. f. techn. Physik,* 16. 11. *pp.* 385–391, 1935. *Phys. Zeits.* 36. *pp.* 779–785, *Dec.* 1, 1935.—The forces governing nuclear structure are discussed theoretically on the grounds of (*a*) the empirically determined binding energy and (*b*) primary β-ray spectra. Under (*a*) theories of light and heavy nuclei are considered in terms of the Thomas-Fermi and Hartree methods, while under (*b*) the consequences of the Fermi theory are examined. F. C. C.

10. Asymmetrical Distribution of Charge in Atomic Nuclei. H. Schüler. *Zeits. f. techn. Physik,* 16. 11. *pp.* 418–420, 1935. *Phys. Zeits.* 36. *pp.* 812–814, *Dec.* 1, 1935.—Theoretical work following Casimir indicates the nuclei of Cu^{63} and Cu^{65}, Hg^{201} and Bi^{209} have a distribution of charge which differs appreciably from spherical symmetry. The results are based on considerations of hyperfine structure. F. C. C.

***11. Synthesis of Radioactive Elements by Deutons Accelerated by an Impulse Generator. F. Joliot, A. Lazard and P. Savel.** *Comptes Rendus,* 201. *pp.* 826–828, *Nov.* 4, 1935.—An impulse generator capable of producing a voltage of 3×10^6 V, combined with an acceleration tube similar to that used by Brasch and Lange [see Abstract 3855 (1931)], are described. This method of accelerating ions is more powerful than the continuous method, and does not require such low pressures in the tube. It is applied to the production of accelerated deutons with which C and B are bombarded, resulting in the formation of radiocarbon, and amounts of radionitrogen much greater than obtainable by bombarding B with α-particles from natural radioactive elements: ${}^{12}_{6}C + {}^{2}_{1}H = {}^{13}_{7}N + {}^{1}_{0}n$ [see Abstract 2259 (1934)]. C. A. S.

12. Radioactivity Induced in Oxygen by Deuton Bombardment. H. W. Newson. *Phys. Rev.* 48. *pp.* 790–796, *Nov.* 15, 1935.—Under bombardment by deutons of 3 MV energy, O is found to give rise to an element emitting positrons with a half-life of 1·16 min. Chemical tests show that the active substance is an isotope of F, the probable reactions being $O^{16} + D^2 \rightarrow F^{17} + n^1$, $F^{17} \rightarrow O^{17} + e^+$. Measurement of the activation function by collecting radioactive recoil atoms at several points along the path of the deuton beam gives a threshold excitation value at 2 MV. The maximum angle between the direction of the deuton beam and the paths of the radioactive recoil atoms was found by reflection at an optical surface of quartz to be about 30° corresponding to an energy absorption of nearly 2 MV. The method was checked by a similar experiment with a graphite sheet when a maximum angle of recoil of 42° was obtained corresponding with the accepted energy of absorption of 0·1 MV for the known reaction $C^{12} + D^2 \rightarrow N^{13} + n^1$. F. C. C.

13. Search for Radioactivity Induced by 800-kV Electrons. J. J. Livingood and A. H. Snell. *Phys. Rev.* 48. *pp.* 851–854, *Dec.* 1, 1935.—A filament is mounted on the h.v. end of a Sloan r.f. resonance transformer and electrons are accelerated out of the vacuum tank through a thin window at a maximum energy of about 850 kV. About fifty elements have been bombarded with these electrons and examined with a Geiger counter for induced radioactivity. No positive results were obtained. This indicates that the yield is less than 1 activation per 10^{12} electrons of approximately 750 kV, provided that the half-lives have values between some seconds and 1–2 hr. and that the products of disintegration are electrons of over 200 kV energy. The collision cross-sections for such reactions have upper limits ranging from 10^{-35} cm^2. for H to 10^{-33} cm^2. for U. AUTHORS.

14. Radioactive Substances from Magnesium. M. C. Henderson. *Phys. Rev.* 48. *pp.* 855–861, *Dec.* 1, 1935.—Under bombardment by 3·3 MEV deutons, Mg becomes radioactive with the emission of negative electrons and γ-rays, and with two decay periods : $10\frac{1}{4} \pm \frac{1}{4}$ min. and $15 \cdot 8 \pm 0 \cdot 5$ hr. These periods are characteristic of Mg^{27} (Fermi) and Na^{24} (Lawrence). The reactions producing these bodies are :

$$_{12}Mg^{26} + {}_1H^2 = {}_{12}Mg^{27} + {}_1H^1 ; \quad {}_{12}Mg^{27} = {}_{13}Al^{27} + \beta + \gamma.$$
$$_{12}Mg^{26} + {}_1H^2 = {}_{11}Na^{24} + {}_2He^4 ; \quad {}_{11}Na^{24} = {}_{12}Mg^{24} + \beta + \gamma.$$

The protons have not been looked for. The α-particles have a range of about 7 cm. The Mg^{27} β-rays have 2·0 MEV maximum energy, and the accompanying hard γ-ray has about 1·3 MEV energy. The voltage excitation functions of these two activities have been measured, and have been found to follow different laws. The Mg^{27} following the Oppenheimer and Phillips function and the Na^{24} the older Gamow function. At 3 MEV one atom becomes Na^{24} for each 9·6 atoms going to Mg^{27}. The thick target yield of Mg^{27} atoms is about 5 per 10^7 deutons. The nuclear cross-section (Mg^{26}) at 3 MEV is about $2 \cdot 4 \times 10^{-26}$. AUTHOR.

15. Artificial Nuclear Disintegration. W. Bothe. *Zeits. f. techn. Physik,* 16. 11. *pp.* 382–385, 1935. *Phys. Zeits,* 36. *pp.* 776–779, *Dec.* 1, 1935.—Review of the method and types of artificial nuclear disintegration together with a statistical survey of the results and an examination of the stability of the products of disintegration. F. C. C.

16. Proton Spectrum of Mg, Si and S under Fast α-Particle Bombardment. O. Haxel. *Zeits. f. techn. Physik,* 16. 11. *pp.* 410–412, 1935. *Phys. Zeits.* 36. *pp.* 804–806, *Dec.* 1, 1935.—Using a Geiger counter, examination is made of the proton spectrum of Mg, Si and S under bombardment with α-particles of range up to 8·6 cm. The observed yield, which is similar for all three elements, is attributed to the disintegration of the chief isotopes Mg^{24}, Si^{28} and S^{32}. From the measured energy of the proton groups the energy of the resulting Al, P and Cl nuclei may be calculated. The similarity in the behaviour of the three elements is attributed to their differing from each other only by the addition of an α-particle. F. C. C.

17. Absorption of Slow Neutrons. I. Kara, L. Rosenkewitsch, C. Sinelnikov and A. Walther. *Phys. Zeits. d. Sowjetunion,* 8. 2. *pp.* 215–222, 1935. *In English.*—Describes measurements of the absorption of slow neutrons in Fe, Cu and Ag, using a silver detector. Fe and Cu have a very small absorption for slow neutrons and reasons for this are put forward. W. E. P.

18. Periodic System of Energy Coefficients. A. E. Fersman. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 4. *pp.* 173–176, 1935. *In English.*—The tabulated values of EK (the amount of energy which an ion of definite valency existing in infinity contributes in passing into a system of a heteropolar crystal lattice) are subjected to a purely geometrical analysis. The curves for anions and kations in the different groups are discussed. Berkenheim's law of additivity is found not to hold to eks. Various conclusions are drawn in the study of EK of definite valency but for different elements. Finally, a number of symbathic and antibathic curves are established. R. S. R.

19. Group Relation between the Mulliken and Slater-Pauling Theories of Valence. J. H. van Vleck. *J. Chem. Phys.* 3. *pp.* 803–806, *Dec.*, 1935.—By means of the group theory of characters, it is shown that there is an intimate relation between Mulliken's molecular orbitals and the Slater-Pauling directed wave functions. It is possible to pass from the former to the latter by making a simple transformation from an irreducible to a reducible representation. Consequently the same formal valence rules are usually given by either method, and it can be understood generally why wave functions of the central atom which are nonbonding in Mulliken's procedure are likewise never employed in constructing Pauling's "hybridised " linear combinations. [See following Abstract.] AUTHOR.

20. Valence Strength and the Magnetism of Complex Salts. J. H. van Vleck. *J. Chem. Phys.* 3. *pp.* 807–813, *Dec.*, 1935.—Certain complex salts, notably ferro- and ferricyanides, have susceptibilities much lower than those predicted by the Bose-Stoner " spin only " formula. The first interpretation was that given by Pauling on the basis of (I) directed wave functions. In the present paper it is shown that alternative explanations are possible with (II) the crystalline potential model of Schlapp and Penney, or with (III) Mulliken's method of molecular orbitals. In any of the theories, the interatomic forces, if sufficiently large, will disrupt the Russell-Saunders coupling, and make the deepest state have a smaller spin, and hence smaller susceptibility, than that given by the Hund rule. This situation is not to be confused with that in normal paramagnetic salts, such as sulphates or fluorides, where only the spin-orbit coupling is destroyed. The similarity of the predictions with all three theories is comforting, since any one method in valence usually involves rather questionable approximations. Because of this similarity a preference between the theories cannot be established merely from ability to interpret the anomalously low magnetism of the cyanides. Covalent bonds, as in cyanides, seem to be more effective in suppressing magnetism than are ionic ones, as in fluorides, but so far the evidence to this effect is empirical rather than theoretical. [See preceding Abstract.] AUTHOR.

21. Quantum Mechanical Discussion of Orientation of Substituents in Aromatic Molecules. G. W. Wheland and L. Pauling. *Am. Chem. Soc., J.* 57. *pp.* 2086–2095, *Nov.*, 1935.—Using the method of molecular orbitals, a quantitative discussion of the charge distribution in aromatic molecules undergoing substitution reactions is carried out, taking into consideration the inductive effect, the resonance effect, and the polarising effect of the attacking group. It is shown that, with reasonable values for the parameters involved, the calculated charge distributions for pyridine, toluene, phenyltrimethylammonium ion, nitrobenzene, benzoic acid, benzaldehyde, acetophenone, benzonitrile, furan, thiophene, pyrrole, aniline, phenol, naphthalene, and the halogen benzenes are in qualitative agreement with experiment regarding position and rate of substitution, the auxiliary hypothesis being made that the rate of substitution of the group R′ for H on the *i*th C atom increases with increase in the negative charge of the *i*th C atom when the group R′ is in position to react. AUTHORS.

22. Molecular Structure of Chloroform by Electron Diffraction. C. Degard. *Comptes Rendus,* 201. *pp.* 951–952, *Nov.* 18, 1935.—The results as regards the molecular structure of chloroform deduced from its examination by the electron diffraction method, are, within the limit of error, consistent with both the ordinary tetrahedral, and the Urbain coordinate ($CH_2 \cdot HCl$) structures. C. A. S.

23. Molecular Structures of SO_2, CS_2, and COS. P. C. Cross and L. O, Brockway. *J. Chem. Phys.* 3. *pp.* 821–824, *Dec.,* 1935.—The structures of the molecules SO_2, CS_2, and COS have been investigated by the electron diffraction method with the following results: SO_2, $S - O = 1{\cdot}46 \pm 0{\cdot}02$ Å; CS_2, $C - S = 1{\cdot}54 \pm 0{\cdot}03$ Å; COS, $C - O = 1{\cdot}16 \pm 0{\cdot}02$ Å, $C - S = 1{\cdot}56 \pm 0{\cdot}03$ Å. The types of bond arrangement compatible with these interatomic distances are discussed. In SO_2 the molecule resonates between the structures having single-double and double-single bonds between the sulphur and the two oxygen atoms, with a bond angle of 122° ± 5°. CS_2 is a linear molecule with the structure having the two double bonds predominating over those having a single and a triple bond. In COS the double-double bond arrangement and the structure having the triple carbon-oxygen bond predominate. AUTHORS.

24. Molecular Structure of Nickel Carbonyl. L. O. Brockway and P. C. Cross. *J. Chem. Phys.* 3. *pp.* 828–833, *Dec.,* 1935.—Electron diffraction by the vapour of $Ni(CO)_4$ leads to a molecular model in which the four carbonyl groups have a tetrahedral arrangement about the nickel atom with the distances $Ni - C = 1{\cdot}82 \pm 0{\cdot}03$ Å and $C - O = 1{\cdot}15$ Å. These distances are compatible with resonance between two electronic structures in which the C – O bond resonates between triple and double electron pair bonds and the Ni – C bond between single and double electron pair bonds. Nickel carbonyl is the first quadricovalent compound of neutral nickel whose structure has been determined, and its tetrahedral configuration is contrasted with the square arrangement of bonds in the quadricovalent compounds of divalent nickel ion. AUTHORS.

25. Possibility of a Metallic Modification of Hydrogen. E. Wigner and H. B. Huntington. *J. Chem. Phys.* 3. *pp.* 764–770, *Dec.,* 1935.—Any lattice in which the H atoms would be translationally identical (Bravais lattice) would have metallic properties. In the present paper the energy of a body-centred lattice of H is calculated as a function of the lattice constant. This energy is shown to assume its minimum value for a lattice constant which corresponds to a density many times higher than that of the ordinary, molecular lattice of solid H. This minimum—though negative—is much higher than that of the molecular form. The body-centred modification of H cannot be obtained with the present pressures, nor can the other simple metallic lattices. The chances are better, perhaps, for intermediate, layer-like lattices. AUTHORS.

See also Abstracts 75, 99, 189, 206, 208, 213, 214, 215, 222, 233, 256, 261, 290, 305, 322.

COLLOIDS.

26. Lyophilic Colloids. Part II. H. G. B. de Jong and W. A. L. Dekker. *Kolloid-Beihefte,* 43. 1–5. *pp.* 143–212, *Nov.* 25, 1935.—By different methods (viscosity measurements, turbidity data, electrophoresis velocities, etc.) coacervation (which means precipitation of a liquid) has now been investigated in acid mixtures of dilute gelatin-gum arabic sols. The main condition for complex coacervation is that opposite charges must be present between the two colloid components, and this occurs at one pH value lower than 4·8 (the isoelectric point of the gelatin) at which the gelatin is positively and the gum arabic negatively charged. The very comprehensive paper now submitted deals with : (1) the influence of mass ratio and pH upon the complex coacervation ; (2) the influence of neutral salts ; (3) the influence of sol concentration ; (4) the electrical character of complex coacervation ; (5) the theory of complex coacervation. The paper is replete with descriptions of experiments, tables of data, and illustrative curves. [For Part I see Abstract 3090 (1934).] H. H. Ho.

27. Cataphoresis of Spherical Particle. S. Komagata. *Electrot. Laborat., Tokyo, Japan. Researches No.* 387 [35 *pp*.]. 1935. *In English.*—The general equation of cataphoresis of a spherical particle is derived when the effect of deformation or polarisation of the ionic atmosphere surrounding it is taken into account, but with the restrictions that the fundamental hydrodynamical equation for a viscous liquid holds both in the bulk of the liquid and within the electrical double layer, and that the motion of the liquid is steady stream-line motion. The deformation effect tends to decrease the cataphoretic velocity. It is shown that this decrease appears in the experimental region. C. B. A.

28. Electrofiltration in Electrolysis of Gels. J. Swyngedauw. *Comptes Rendus*, 201. *pp*. 821–823, *Nov*. 4, 1935.—The phenomena of kathodic and anodic swelling previously described [see Abstracts **3094** and **3470 (1934)**] may be summarised in the statement that if in any region the gradients of ionic concentration and of electrofiltration are in the same direction swelling occurs, if in opposite then depression. It is also shown that isoelectric depression is due to electrofiltration. C. A. S.

29. Light Scattering in Gold Sols in Relation to Particle Size and Shape. D. S. Subbaramaiya. *Indian Acad. Sci., Proc.* 2*A*. *pp*. 358–363, *Oct*., 1935.—Previous work on gold sols with reference to the shape of the particle is briefly recounted. Results of the measurements of the depolarisation of Tyndall scattering corresponding to the incident light being (*a*) unpolarised, (*b*) plane polarised with its electric vector perpendicular to the plane of observation, (*c*) plane polarised with its electric vector parallel to the plane of observation, are reported. The values obtained and the observation made indicate that the particles in Faraday's sols are much smaller as compared with those in the other red sols prepared by using nuclear sols and H_2O_2 as the reducing agent ; those in the blue sols are relatively the largest. In the sols examined the shapes of the particles are far from being spherical. In general the size and the anisotropy of the particles appear to increase with the increase in the rate of growth brought about by enhancing the temperature during the preparation of the sol. The addition of K_2CO_3 to the mixture before reduction seems to have the reverse effect. [See also Abstract **2989** (1935).] AUTHOR.

30. Distances between Colloidal Particles in Iridescent Strata of Ferric Oxide Sols. W. Heller. *Comptes Rendus*, 201. *pp*. 831–833, *Nov*. 4, 1935.—The distances (*d*) between layers of tactoids (the platelets which produce by interference the iridescent colours in sols of Fe_2O_3 prepared under certain conditions by hydrolysis of solutions of $FeCl_3$) are

determined for solutions of $FeCl_3$ of initial concentrations (c) 0·0408 – 0·0628 M, after periods of 59–1695 days. For the same period d is a maximum (2000–3000 Å) for approximately $c = 0{\cdot}05\ M$; with c constant d increases with time, but with some indication of a maximum between 190 and 248 days and subsequent decline. The changes are consistent with slow increase in charge of the particles resulting from increase in concentration of H-ions through slow continuing hydrolysis.
C. A. S.

31. Bound Water in Hydrophilic Colloids at Low Temperatures. W. H. Barnes and W. F. Hampton. *Canad. J. of Research*, 13. *Sect. B. pp.* 218–227, *Oct.*, 1935.—A new method for the study of hydrophilic colloids by the application of X-ray methods of analysis to the frozen gels is described. The possibilities of the method and its limitations are shown by a qualitative study of the amount, and variation with temperature, of the so-called " bound " water in gelatin gels over the temperature range – 3° to – 50° C. [See Abstract 72 (1936).] AUTHORS.

32. Diffusion in Gelatin and Rhythmic Precipitations of Magnesium Hydroxide. G. Ammon and R. Ammon. *Kolloid Zeits.* 73. *pp.* 204–219, *Nov.*, 1935.—The rhythmic precipitation of $Mg(OH)_2$ in gelatin filled tubes is studied, wherein the behaviour of the NH_3 diffusion (observed by means of bromothymol blue) and exact measurement of the ring phenomena are determined. Previous conclusions are ratified, viz., that the diffusion law *per* the NH_3 penetration, the spreading-hypothesis *per* precipitation formation and the interval law possess only a limited validity. Comparative viscosity measurements by the method of the sinking-sphere indicate that the gels become harder with increasing gelatin concentration and softer with increasing $MgCl_2$ content. In this way a regular connection is established between the different concentration conditions and the sinking data, which enables conclusions to be drawn respecting the diffusion of NH_3. On the other hand, the NH_3 diffusion is dependent on its exhaustion produced by the chemical changes. Schleussner's formula for calculating the order-number of a ring is found to be inaccurate. The regularity observed by Michaleff, Nikiforoff and Schemjakin that the product of the average velocity of the diffusion field and the average distance apart of consecutive layers is constant, is now confirmed, but Christiansen and Wulff's generalisation that this product has the same value for every concentration cannot be ratified. On the other hand, the product of the momentary velocity of formation of the precipitate and the relevant distance between two layers appears to be a constant independent of the concentration conditions, and also follows as a consequence of the main principles established. The paper is replete with experimental data. H. H. Ho.

***33. X-Ray Investigation of Elastic Filaments. H. Kolpak.** *Kolloid Zeits.* 73. *pp.* 129–142, *Nov.*, 1935.—The work embraces the study of filaments and ligaments when systematically wetted and dried at different degrees of extension and also when examined with X-rays at different angles of incidence. The extensometer and X-ray apparatus used are described. With no extension and perpendicular incidence for absorption of moisture two haloes are shown, the inner one of which has four maxima. For desorption under the same conditions, two haloes plus ring interference are seen, the inner halo again showing four maxima. At 75 % extension the wet and dry diagrams of the fibre are unchanged, but at 200 % whilst the fibre diagram remains the same, meridian and equatorial interference increases in intensity. If parallel incidence is used, then only ring interference is produced and from 75 % to the maximum extension three new interference rings are developed. At oblique incidence no new interference rings are seen. By desorption two haloes, which are generally observed under all conditions, become smaller, the equatorial interference alters its position but the four maxima and the meridian interference are unchanged. The high-valence theory of Meyer and Mark, as also Astbury, for such materials is applicable in this case. The alteration seen in this case with skin ligaments is similar to that obtained with rubber. The ring interference phenomenon produced by parallel incidence at 75 % extension, etc., is ascribed to the parallelism of the primary cells to the fibre axis under these conditions. From 75 % to 135 % the Astbury explanation of a screw thread is applied. With regard to water content it is estimated that the intramicellar water represents about one-fourth of the total held. S. G. B.

34. Colloid Chemical Phenomena in Metals. J. A. Kljatschko. *Kolloid Zeits.* 73. *pp.* 226–236, *Nov.*, 1935.—The system gas-metal (Al) is studied as a problem in colloidal chemistry. The general laws which are valid for a gas-metal system are briefly summarised, followed by a description and discussion of the results obtained by earlier workers on the interaction of gas and Al and its alloys. The amount of gas which dissolves in Al (chiefly H_2) differs according to whether the determination is made by analysis following extraction by heat or by the equilibrium method. Suggestions are made to account for this discrepancy. The origin of the gas is shown to be due to the reaction between the metal and the water vapour adsorbed in its pores. H. J. H. S.

See also Abstracts 72, 76, 139, 305.

CRYSTAL STRUCTURE AND PROPERTIES.

35. Electronic States in Crystal Lattices. F. Hund. *Zeits. f. techn. Physik*, 16. 11. *pp.* 494–497, 1935. *Phys. Zeits.* 36. *pp.* 888–891, *Dec.* 1, 1935.—Bloch's expression $u(r) = p(r)e^{2\pi ikr}$, in the usual notation, leads to a relationship between K, E (energy), and the lattice distances. The particular cases derived are the row of points, net, diamond, wurtzite. F. I. G. R.

36. Solid Solution. H. O'Daniel. *Zeits. f. Krist.* 92. *pp.* 221–252, *Dec.*, 1935.—The question of super-lattices is considered theoretically. Mixed crystals of NaCl and AgCl, and of TlCl and CsCl are examined by X-ray diffraction, Al and Cr radiation being used. The arrangement is similar to that previously described [see Abstract 3122 (1934)]. Both NaCl/AgCl and TlCl/CsCl form continuous series of solid solutions. In the case of NaCl/AgCl a super-lattice ought to be found, with $a = 11 \cdot 234$ Å. For TlCl/CsCl the lattice constant of the super-lattice ought to be $15 \cdot 3769$ Å. The experimental results, however, do not agree with these figures nor are they consistent among themselves. Reasons for these discrepancies are advanced. J. T.

37. Alternating Axes and Symmetry Symbols in Crystallography. J. D. H. Donnay. *Washington Acad. Sci., J.* 25. *pp.* 476–488, *Nov.* 15, 1935.

38. Lattice Constants and Refractive Indices of Crystals of Bismuth and Antimony. E. Rosa. *N. Cimento*, 12. *pp.* 448–454, *July*, 1935.—The spacings of the (III) planes of Bi and Sb crystals are measured using Adinolfi's method. This reduces the errors and simplifies the Bragg method. The mean values (for Cu and Fe K α- and K β-radiations) are 3·957 and 3·754 Å for Bi and Sb respectively, as compared with 3·92 and 3·77 found by Ogg [see Abstract 1966 (1921)] using Pd and Rh K-radiations. The refractive indices are calculated from the corrected Bragg formula. The value of $(1-\mu)$ increases from $0{\cdot}4 \times 10^{-5}$ to $1{\cdot}1 \times 10^{-5}$ with increase of wave-length from 1·38 to 1·93 Å, in qualitative agreement with the theory of Kallmann and Mark. C. J. B. C.

39. Pd-Ag-H Alloys. G. Rosenhall. *Ann. d. Physik*, 24. 4. *pp.* 297–325, *Oct.*, 1935.—The ternary system Pd-Ag-H is investigated by electrical methods and by means of X-rays. The introduction of Ag into the Pd-H system has the effect, for a definite concentration of Ag, of causing the break in the solubility curve to disappear so that for all H-concentrations a single-phased alloy is obtained. The electrical resistances of various alloys are measured and the relationship between resistance and lattice constant is discussed. The X-ray results do not settle the question of whether the H atoms fill up the interstices in the lattice or are part of the structure, but the resistance measurements support the second alternative. J. T.

40. Structure of Aluminium-Lithium Alloys. G. Komovsky and A. Maximow. *Zeits. f. Krist.* 92. *pp.* 275–283, *Dec.*, 1935.—The equilibrium diagram of the AlLi alloys is investigated in the whole of the region up to a concentration of 20·5 % Li by means of the X-ray method. The presence of two phases is recognised, in accordance with the equilibrium diagram. It is shown that the β-phase constitutes an intermetallic compound having the formula AlLi. The character of the α-phase is not strictly defined by the X-ray method employed in the investigation. F. J. B.

41. Lattice Structure of Lithium-Aluminium Alloys. E. Zintl and G. Woltersdorf. *Zeits. f. Elektrochem.* 41. *pp.* 876–879, *Dec.*, 1935. —LiAl alloys are prepared by melting the components in an A atmosphere. X-ray analyses of alloys containing up to 50 atomic % Li show only one intermediate phase, LiAl; this has a cubic body-centred lattice of the type NaTl with a constant 6·360 Å and an atomic radius 1·38 Å (for Li it is 1·52 Å). H. J. H. S.

42. Lattice Constants of Beryllium. E. A. Owen and L. Pickup. *Phil. Mag.* 20. *pp.* 1155–1158, *Dec.*, 1935.—The lattice constants of Be, redetermined by means of a spectrum camera of special design and Cohen's method of calculation [see Abstract 1381 (1935)], are a $2{\cdot}2810_5$, b $1{\cdot}5682_0$, in close agreement with the authors' previous results [see Abstract 2815 (1935)]. C. A. S.

43. Metallic Transformations Extending over a Temperature Range. A. Schulze. *Zeits. f. Metallkunde*, 27. *pp.* 251–255, *Nov.*, 1935. —Transformations in which the lattice structure does not change and which extend over a range of temperature are discussed with reference to a few examples which have been examined previously by the author [see Abstract 3560 (1935)]. Certain anomalies are observed in the characteristic transformation curves at temperatures below those at which transformation begins. The work of Grube and others on transformations in the Au-Cu system show similar anomalies; these are described in some detail. The examples drawn from the work of the author are the (magnetic) transformation of Ni, Ni alloys and Fe and of β-brass. The anomalies are best illustrated by means of the thermal expansion and resistance-temperature curves; it is shown that the anomalous behaviour sets in at a temperature of 160° below the beginning of the characteristic transformation temperature in the case of β-brass, 100° for Ni, *c.* 50° for Fe, 100–130° for Ni alloys and 150–180° for $AuCu_3$ and AuCu. No explanation of the phenomena is offered. H. J. H. S.

44. Iron of High Purity. F. Adcock and C. A. Bristow. *Roy. Soc., Proc.* 153 *A. pp.* 172–200, *Dec.* 2, 1935.—An account is given of the work which has been performed at the N.P.L. on high purity iron for about 11 years. The mode of preparation and analyses of 5 batches are briefly described. The final batch of iron is prepared by passing pure H_2 over the oxide produced from pure ferrous chloride and subjecting the product so obtained to a further H_2 treatment; this treatment is described fully as it is only after much attention to detail that a high purity product is obtained. The lattice parameter ($2 \cdot 860_6$ A for α-iron), density ($7 \cdot 871 \pm 0 \cdot 002$ gm./cc.), coefficient of expansion, electrical resistivity, thermal conductivity, magnetic properties, mechanical properties and transformations are given. It appears that the α-γ transformation in high purity iron is not a simple phase change occurring at a constant temperature but is a more complex transformation and further work is desirable to elucidate this much-discussed question. H. J. H. S.

45. Al Compounds with Spinel Structure, and γ-Ferric Oxide. Mineralising Action of Fluorides. E. Kordes. *Zeits. f. Krist.* 91. *pp.* 193–228, *Sept.*, 1935.—Magnesium spinel, $Mg_2Al_2O_4$, $LiAl_5O_8$ (prepared by heating Li_2O and Al_2O_3 in presence of LiF or AlF_3, the F greatly accelerating the reaction and exemplifying its mineralising power), and γ-Al_2O_3 all have the same spinel structure, and form solid solutions *inter se*. Their unit cells have *a* 8·08, 7·903 and 7·895 Å respectively. The isomorphism of $LiAl_5O_8$ is explained as due to its being $(LiAl)Al_2O_4$, $(LiAl^{III})$ replacing $(2Mg^{II})$. From the value of *a* and the density, 3·619, the unit cell of γ-Al_2O_3 contains $10\frac{2}{3}$ Al_2O_3, or with *a* doubled $85\frac{1}{3}$. But it always contains (according to the method of preparation) small amounts of Li_2O or H_2O, which are only lost about 1600° or 1000°, when it passes into γ-Al_2O_3. These facts are explained by assuming that the unit cell contains 256O, 170Al and 2Li (or H) atoms, which allows for 0·34 % Li or 0·21 % H. Similarly the spinel structure of γ-Fe_2O_3 is attributed to the presence of $1Fe^{II}$ per 170 Fe^{III} and 256O. C. A. S.

46. Structure of Solid Solutions of Fe_2O_3 in Mn_3O_4. E. J. W. Verwey and M. G. van Bruggen. *Zeits. f. Krist.* 92. *pp.* 136–138, *Oct.*, 1935.—As γ-Fe_2O_3 has an averaged structure, the unit cell containing 32O ions (face-centred positions) with an average of $21\frac{1}{3}$ Fe^{III} ions distributed statistically over 24 spinel positions, so in oxidised manganous ferrite of composition $Mn_3O_4 \cdot 3Fe_2O_3$ the O skeleton is the same with 7·4Mn and 14·8 Fe ions similarly distributed over the 24 spinel positions. Solid solutions of Fe_2O_3 in Mn_3O_4 (prepared by heating the mixed oxides to 900–1300° and cooling rapidly) show with increasing proportion of Fe_2O_3 increasing approximation to cubic structure, *c*/*a* decreasing from 1·16 for Mn_3O_4 to 1·05 for Mn/Fe = 67/33 and 1·00 for 60/40 or less [see preceding Abstracts]. C. A. S.

47. Structure of Julienite. A. Schoep and V. Billiet. *Zeits. f. Krist.* 91. *pp.* 229–234, *Sept.*, 1935. *In French.*—Julienite from Chamibumba (Katanga) is identical with artificial $Na_2Co(SCN)_4 \cdot 8H_2O$, and is tetragonal with *a* 9·22, *c* 5·56 and 1 molecule in unit cell, density 1·648; birefringence strong, ϵ 1·645, ω 1·556. C. A. S.

48. Structure of the Isomorphous Group (Si^{4+}, Ti^{4+}, Zr^{4+}, Sn^{4+}, Hf^{4+}) P_2O_7. G. R. Levi and G. Peyronel. *Zeits. f. Krist.* 92. *pp.* 190–209, *Dec.*, 1935. *In Italian.*—These pyrophosphates crystallise in the cubic (as well as other) system, the space group being T_h^6 – Pa3. The number of molecules in the unit cell is 4 and the lattice constants ($a_0 \pm 0{\cdot}01$Å) and calculated densities are: Si, 7·46 Å, 3·232; Ti, 7·80 Å, 3·106; Sn, 7·89 Å, 3·957; Zr, 8·20 Å, 3·195; Hf, 8·18 Å, 4·278. The positions of the separate atoms and the atomic distances are worked out for the Zr salt. T. H. P.

49. Structure of NiS and NiSe. G. R. Levi and A. Baroni. *Zeits. f. Krist.* 92. *pp.* 210–215, *Dec.*, 1935. *In Italian.*—γ-NiS, obtained from $NiSO_4$ solution containing H_2SO_4, is identical with millerite (rhombohedric; $a = 9{\cdot}61$, $c = 3{\cdot}15$ Å, $c : a = 0{\cdot}32$, β-NiS, obtained from the acetate solution, is identical with ordinary synthetic NiS (hexagonal; $a = 3{\cdot}42$, $c = 5{\cdot}30$ Å, $c : a = 1{\cdot}55$. α-NiS, obtained by precipitation with $(NH_4)_2S$, is amorphous; it changes in the air, but does not become crystalline. By means of electron interference, the spontaneous transition of γ—into β-NiS—which occurs at the ordinary temperature—was observed. NiSe shows behaviour similar to that of NiS. α-NiSe is amorphous. β-NiSe is identical with the ordinary synthetic NiSe (hexagonal; $a = 3{\cdot}66$, $c = 5{\cdot}33$ Å, $c : a = 1{\cdot}46$). γ-NiSe, only detectable by electron rays, has a rhombohedric form analogous to that of millerite ($a = 9{\cdot}84$, $c = 3{\cdot}18$ Å, $c : a = 0{\cdot}32$); it changes spontaneously into β-NiSe. T. H. P.

50. Structure of Hydrates of Sodium Diborate. W. Minder. *Zeits. f. Krist.* 92. *pp.* 301–309, *Dec.*, 1935.—Kernite, $Na_2B_4O_7 \cdot 4H_2O$, *d* 1·937, is monoclinic, *a* 6·96, *b* 9·14, *c* 15·52, Å, β 108° 52′, 4 molecules in unit cell, space group C_{2h}^4; corresponding data for tincalconite, $Na_2B_4O_7 \cdot 5H_2O$, are 1·937, rhombohedral, *a* 9·46, α 71° 42′, 3 (or hexagonal, *a* 11·3, *c* 20·9, 9), C_{3i}^2, or less probably D_3^7; and for borax, $Na_2B_4O_7 \cdot H_2O$, 1·705, monoclinic, *a* 11·82, *b* 10·61, *c* 12·30, α 106° 35′, 4, C_{2h}^6. By comparing the unit cells of the tetra- and penta-hydrates with the diameter of the H_2O molecule [see Abstract 3951 (1933)] it is inferred that H_2O in these hydrates has a molecular volume 30 % < in free H_2O. C. A. S.

51. Lattice Constants of Silicon. M. C. Neuburger. *Zeits. f. Krist.* 92. *pp.* 313–314, *Dec.*, 1935.—For specially pure Si, the mean value $a = 5{\cdot}4173 \pm 0{\cdot}0005$ Å at 20° C. is found. F. I. G. R.

52. Structures of Diamminopalladium Compounds. F. G. Mann, Dorothy Crowfoot, D. C. Gattiker and Nora Wooster. *Chem. Soc., J. pp.* 1642–1652, *Nov.*, 1935.—In diamminopalladium dichloride Pd atoms are assigned to a face-centred lattice. Various halvings observed in weak spots, but no structure for the whole lattice can yet be suggested. Diamminopalladium oxalate (III) has a space-group P2, or $P2_1/m$: apparently the substance is not pyroelectric, which favours the latter. *Trans*-diamminopalladium dinitrite (IV) is probably optically negative and not pyroelectric. A number of other compounds are more briefly discussed, and a thorough account is given of the chemical properties of members of the series. F. I. G. R.

53. Structure of Ice at Low Temperatures. E. F. Burton and W. F. Olliver. *Roy. Soc., Proc.* 153*A*. *pp.* 166–172, *Dec.* 2, 1935.—

An investigation is reported of the structure of ice formed from the vapour at low temperatures and pressures, using the method of X-ray diffraction. When the vapour is condensed on a surface maintained at a temperature below − 110° C., the condensate is vitreous, and above this temperature a semi-crystalline or crystalline solid is formed. AUTHORS.

54. Polymorphism, Principally of the Elements, up to 50,000 kg./cm^2. P. W. Bridgman. *Phys. Rev.* 48. *pp.* 893–906, *Dec.* 1, 1935.—A new technique is described by which pressures of 50,000 kg./cm^2. and may be applied to solids, and the parameters of any transitions measured. A systematic examination has been made for polymorphism of many of the elements in the new pressure range. New modifications are found for Bi, Hg, Tl, Te, Ga, and I_2, and the transition parameters measured. A beginning has been made of a systematic study of polymorphism of compounds, and results obtained for KCl, KBr, and KI, which assume at about 20,000 kg./cm^2. presumably the CsCl type of structure. AUTHOR.

55. Effect of Crystal-Size on Lattice-Dimensions. G. I. Finch and S. Fordham. *Phys. Soc., Proc.* 48. *pp.* 85–94, *Jan.* 1, 1936.—The lattice constants of the Li, Na and K halides are determined by the method of electron-diffraction, gold and graphite being used as reference standards. It is found that crystal-size can and does exert an appreciable effect upon the lattice-dimensions. AUTHORS.

56. Transitions in Camphor and Chemically Related Compounds. Part I. Dipole Rotation in Crystalline Solids. W. A. Yager and S. O. Morgan. *Am. Chem. Soc., J.* 57. *pp.* 2071–2078, *Nov.*, 1935.—A study of the dielectric properties of *d*-camphor, *dl*-camphor, *d*-camphoric anhydride, borneol, isoborneol and bornyl chloride has shown that these materials undergo solid-solid transitions. These phase changes have not been previously reported in the literature except for *d*-camphor. Above the transition the value of the dielectric constant of the solid is that normally expected of the polar material in the liquid state. Below the transition the dielectric constant has a low value, approximately equal to the square of the optical refractive index. The above dielectric behaviour is explained by the rotation of dipoles in the solid. [See following Abstract.] H. H. HO.

57. Transitions in Camphor and Chemically Related Compounds. Part II. Vibration of Atomic Groups. A. H. White and S. O. Morgan. *Am. Chem. Soc., J.* 57. *pp.* 2078–2086, *Nov.*, 1935.—A rise of about 18 cal./°C./mol. in the specific heat of *d*-camphor at the transition at − 30° is observed, and is explained by assuming that unusually energetic intramolecular vibration arises at the transition temperature. This rise of molecular rotation, evidenced by dielectric data, is qualitatively explained in terms of Pauling's theory of molecular rotation in crystals, by assuming that the forces opposing this rotation are greatly diminished by a transition which reduces the rigidity of the molecules. The behaviour of total polarisation of *d*-camphor in dilute solution is explained by assuming that at room-temperature dipole moment is smaller and atomic polarisation much larger than formerly supposed, and that the latter polarisation begins to decline with temperature below − 10° when the transition to the more rigid molecules begins. Transitions very similar to that occurring in *d*-camphor are observed in crystals of derivatives of cyclohexane, whose carbon ring is supposed to be very pliable in the *cis* form and relatively rigid in the *trans* form. These transitions appear to be due to transformations from the rigid to the pliable forms of the molecules of which the crystals are composed. [See preceding Abstract.] H. H. Ho.

58. Structure of Nitrogen-Substituted Sulphonanilides. G. H. Young, W. J. Keith and A. P. Honess. *Zeits. f. Krist.* 92. *pp.* 216–220, *Dec.,* 1935. *In English.*—*p*-Toluenesulphon-N-isopropylanilide forms monoclinic-prismatic crystals, $a : b : c = 1 \cdot 6700 : 1 : 0 \cdot 9020$, $\beta = 66°51'$. *p*-Toluenesulphon-N-*n*-butylanilide forms (1) orthorhombic crystals (bipyramidal class), $a : b : c = 2 \cdot 1024 : 1 : 1 \cdot 5697$; (2) monoclinic crystals (prismatic class), $a : b : c = 2 \cdot 1510 : 1 : 0 \cdot 8895$, $\beta = 73° \; 52' \; 30''$. *p*-Toluenesulphon-N-sec.-butylanilide forms monoclinic-prismatic crystals, $a : b : c = 2 \cdot 2390 : 1 : 2 \cdot 8161$, $\beta = 71° \; 21' \; 18''$. T. H. P.

59. Structure of Condensed Ring Compounds. Part I. 1 : 2-Cyclo-Pentenophenanthrene. J. Iball. *Zeits. f. Krist.* 92. *pp.* 293–300, *Dec.,* 1935.—An X-ray study of the crystal structure of 1 : 2-cyclopentenophenanthrene shows that the crystals are monoclinic with unit cell dimensions: $a = 18 \cdot 38$; $b = 5 \cdot 83$; $c = 23 \cdot 61$ Å; $\beta = 114 \cdot 3°$. Measured density $= 1 \cdot 23$; 8 molecules per unit cell; space group $B2_1/c$. The position and orientation of the molecules are found from a comparison of the intensities of reflections with those of chrysene. Photographs taken about the *b* axes of the two compounds show a marked resemblance which suggests that the molecules in each case are similarly orientated when the cell is viewed along the *b* axes. AUTHOR.

60. Structure of Para-Dinitrobenzene. R. W. James, G. King and H. Horrocks. *Roy. Soc., Proc.* 153*A*. *pp.* 225–246, *Dec.* 2, 1935.—The method of double Fourier series is applied to determine the crystal structure of para-dinitrobenzene. Projections of the electron density on the three axial planes are made, and the 18 independent parameters of the structure are measured. The space-group is $P \, 2_1/n$, and the unit cell contains two molecules. The molecule must therefore have a centre of symmetry. The benzene ring, although nearly a regular hexagon of side 1·40 Å, appears slightly distorted to an extent which should rather be greater than the experimental error. The length of one of each of the pairs of sides adjacent to the C — N link is shortened to 1·32 Å. The distortion appears to be due to the displacement of the C atoms which are linked to the nitro groups. The C — N link lies nearly in the plane of the ring, but is inclined at about 25° to the plane of the NO_2 group. The N — O distances are not quite equal, being 1·10 Å and 1·25 Å. The O — O distance is 2·14 Å. The closest approach of O to CH in adjacent molecules is 3·30 Å. A discussion of the packing of the molecules in the structure is given. AUTHORS.

61. Structure of Iridescent Shells. Part II. The Haliotidæ. S. R. Swamy. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 343–351, *Oct.,* 1935.—X-ray diffraction patterns, obtained with monochromatic X-rays, of some species of *Haliotis* shells are studied. It is found that the patterns given by these shells with normally incident X-rays are somewhat different from those previously obtained with *Turbo* and *Trochus*. In the latter shells there is random orientation of the *a* and *b* axes of aragonite crystallites, but in *Haliotis* species instead of random orientation of this type there is preferred orientation of the *a* and *b* axes with a large error in orientation. The *c* axis is normal to the laminations as in all the other aragonite shells examined previously. Patterns obtained with *Nautilus pompilius* and *M. vulgaris* are measured and the Bragg planes causing the various reflections identified. From these measurements, the type of orientation of twin crystals of aragonite suggested for *Nautilus* in the author's previous paper [see Abstract 3746 (1935)] is confirmed. Also the nacreous layer of *M. vulgaris* is found to consist of single crystals of aragonite with their 110 planes parallel to the lines of growth, and the *c* axis normal to the shell surface. AUTHOR.

62. Nature of U-Centres in Alkali Halide Crystals. P. Tartakowsky and W. Poddubny. *Zeits. f. Physik*, 97. 11–12. *pp*. 765–773, *Nov.* 25, 1935.—It is found that when crystals of rock-salt are heated from 550°–600° C. the absorption of infra-red light of wave-lengths $\lambda \cong 1{\cdot}2\mu$ increases strongly, a fact which corresponds to the transition of the electrons from the ground zone of possible energy values to the U-level. The transition of U-bands into F-bands for different illuminations is studied, and it is shown that electrons can pass from the U- into the F-level in two different ways [directly (by absorption of light quanta $\cong$ 4 volts) and indirectly, when they are first centrifuged into the conduction zone (light quanta 6·4 volts)]. The latter process can give rise to a photoelectric current which is conditioned by the short wave ultra-violet and, like the ordinary photoelectric current, decreases with the time during which an opposed voltage forms. Electrons of the U-centres can recombine with the Cu^+-ions which enter the crystal, and so give rise to the observed red colouring of the crystal. Based upon these experiments (and especially on the infra-red absorption) the authors are inclined to regard the U-centres as electrons which are in the places of wandered Cl^- ions in the crystal lattice, according to the first conception of Hilsch and Pohl. [See Abstract 2059 (1935).] H. H. Ho.

63. Electronic and Ionic Conduction in Non-Metallic Solids. B. Gudden and W. Schottky. *Zeits. f. techn. Physik*, 16. 11. *pp*. 323–327, 1935. *Phys. Zeits*. 36. *pp*. 717–721, *Dec.* 1, 1935.—Recent contributions made in connection with problems of electronic and ionic conduction in non-metallic solids are reviewed. Reference is made to the important bearing of holes in the lattice on ionic conduction, and of disturbances on electronic conduction. The general mechanism of conduction is further considered. R. W. P.

64. Defective Arrangement Phenomena in Ionic Lattices as a Basis for Ionic and Electronic Conduction. C. Wagner. *Zeits. f. techn. Physik*, 16. 11. *pp*. 327–331, 1935. *Phys. Zeits*. 36. *pp*. 721–725, *Dec.* 1, 1935.—Refers to the theories of Smekal, Frenkel and Schottky and the three basic types of defective states which have been suggested by Wagner and Schottky, *viz.*, inter-lattice space type, vacant position type and substitution type. Examples of each are given and discussed with particular reference to conduction. Reference is also made to recent work by the present authors and collaborators on the dependence of the electrical conductivity of oxides on oxygen pressure, three groups of oxides being formed according as the conductivity decreases, increases or is independent of increase in oxygen pressure. These results are examined in the light of the present theory. R. W. P.

65. Theory of the Movement of Electrons in Non-Metallic Crystal Lattices. F. Hund. *Zeits. f. techn. Physik*, 16. 11. *pp*. 331–335, 1935. *Phys. Zeits*. 36. *pp*. 725–729, *Dec.* 1, 1935.—A survey is given of the explanations which have been proposed relating to the complicated phenomena involved in electronic conduction in non-metallic crystals. After describing the states of electrons in solids the author deals with electronic conduction in perfect and in disturbed non-metallic crystal lattices. R. W. P.

66. Electron Conduction in Alkali Halide Crystals. R. W. Pohl. *Zeits. f. techn. Physik*, 16. 11. *pp.* 338–341, 1935. *Phys. Zeits.* 36. *pp.* 732–735, *Dec.* 1, 1935.—The thermal equilibrium between U- and F-centres in alkali halides with a stoichiometrical alkali metal excess is discussed. The part played by the centres in electron conduction is described and the optical and electrical methods of verification are given. A summary of the recent literature on the subject is included. H. J. H. S.

67. Thermal Formation and Life of Colour Centres in KBr. R. Hilsch. *Zeits. f. techn. Physik*, 16. 11. *pp.* 341–343, 1935. *Phys. Zeits.* 36. *pp.* 735–737, *Dec.* 1, 1935.—KBr crystals with a stoichiometrical excess of metal possess the typical properties of a semi-conductor. The metal excess exists in 2 different forms, *viz.*, as U- and F-centres which are in thermal equilibrium. The dissociation of the U-centres at different temperatures and concentrations, the thermal transformation of U- into F-centres and the life of F-centres in KBr are discussed. Finally, the relation between the life of the colour centres and the temperature is given graphically. H. J. H. S.

68. Thermal Diffusion of Colour Centres. O. Stasiw. *Zeits. f. techn. Physik*, 16. 11. *pp.* 343–346, 1935. *Phys. Zeits.* 36. *pp.* 737–740, *Dec.* 1, 1935.—The thermal diffusion of colour centres in KCl is measured. From the results so obtained and from the previous measurements of the mobilities of the colour centres, the positive charge in the crystal is calculated. It is found that, below 700° C., the electrons in the crystal have a greater mobility than the positive ions whereas above 700° C. they have approximately the same. H. J. H. S.

69. Electron Conduction in Melts of Alkali Salts with a Stoichiometric Excess of Alkali Metal. E. Mollwo. *Zeits. f. techn. Physik*, 16. 11. *pp.* 346–348, 1935. *Phys. Zeits.* 36. *pp.* 740–742, *Dec.* 1, 1935.—The p.d. developed between 2 electrodes immersed in alkali salt melts of different concentrations is measured. If one electrode is immersed in an unsaturated solution and the other in a saturated, a point is found at which saturation concentration is reached (when the p.d. is zero). The saturation concentration for a KBr melt at 850° C. is $2 \cdot 3 \times 10^{20}$ and for NaBr at 870° C. $7 \cdot 4 \times 10^{19}$ atoms/cm^3. The electron mobility is deduced and brief reference is made to the production of colour centres. [See also Abstract 4418 (1934).] H. J. H. S.

70. Retarding Potential in Solid Ionic Conductors. A. Smekal. *Zeits. f. techn. Physik*, 16. 11. *pp.* 348–355, 1935. *Phys. Zeits.* 36. *pp.* 742–749, *Dec.* 1, 1935.—A survey is made of recent work on solid ionic conductors, which throws light on the nature of the dielectric anomalies of ionic crystals. It is shown that, particularly in the case of rock-salt, the Maxwell-Wagner theory of heterogeneous solid dielectrics, and also the Jaffé theory give results which are not in accord with experiment. A new and more satisfactory theory of ionic migration in heterogeneous crystals, which explains the experimental results, is outlined. J. E. R.

71. Energies of Defective Ionic Arrangements and Dependence on Pressure. W. Jost. *Zeits. f. techn. Physik*, 16. 11. *pp.* 363–366, 1935. *Phys. Zeits.* 36. *pp.* 757–760, *Dec.* 1, 1935.—By consideration of the polarisation effect the order of magnitude of the energy of defective arrangement of ions in a crystal can be calculated. Although the calculation is only of the nature of an approximation it suffices, in many cases, to decide the question whether the defective arrangement is present in the manner suggested by Frenkel or by Schottky. Further inferences from the theory, in particular the influence of pressure on the conductivity and the degree of defective arrangement, are discussed. R. W. P.

***72. Variable Temperature X-Ray Powder Camera. W. H. Barnes and W. F. Hampton.** *Canad. J. of Research,* **13.** *Sect. A. pp.* **73–81,** *Oct.,* **1935.** *Rev. Sci. Instruments,* **6.** *pp.* **342–344,** *Nov.,* **1935.**—Designed for obtaining diffraction patterns of frozen gelatin gels at predetermined constant temperatures between — 60° and 0° C., the camera differs from others in the method of mounting the specimen on the surface of a cylindrical copper block, the temperature of which is maintained by the circulation of pre-cooled acetone. The X-rays pass vertically through the camera, through a small hole in the block, over which the specimen is placed. The plate-holder is supported above the specimen by a wide brass tube. Different plate distances are obtained by means of a set of tubes of suitable heights. The camera seems very convenient for the examination of a variety of materials over a considerable temperature above and below 0° C. [See Abstract 31 (1936).] C. J. B. C.

See also Abstracts **18, 31, 33, 75, 83, 196, 309, 315.**

DENSITY.

See Abstracts **44, 47, 113, 307.**

DIFFUSION AND OSMOSIS.

73. Diffusion Constants of Gases. J. Kuusinen. *Ann. d. Physik,* **24. 5.** *pp.* **445–446,** *Nov.,* **1935.**—Reference is made to the work of Trautz and Müller [see Abstract 2376 (1935)] in which it was stated that Fick's law only applied to stationary diffusion processes in which there was a linear concentration gradient. The author points out that since Fick's law only relates to true diffusion it should not have been applied to a case in which the total transfer included that due to convection. When allowance is made for convection it is found that the diffusion constant is identical with that of Maxwell-Chapman recommended by Trautz and Müller. [See following Abstract.] R. W. P.

74. Definitions of Diffusion Constants. J. Kuusinen. *Ann. d. Physik,* **24. 5.** *pp.* **447–456,** *Nov., and* **24. 8.** *p.* **752,** *Dec.,* **1935.**—For the case of one dimensional diffusion in a binary mixture it is considered that the diffusion coefficient, k, is given quite generally by the two equations, $c_1 = w\gamma_1 - k\,\delta\gamma_1/\delta x$ and $c_2 = w\gamma_2 - k\,\delta\gamma_2/\delta x$, where at any instant γ_1 and γ_2 are the absolute concentrations of the two substances in unit volume at the coordinate x, and c_1 and c_2 are the quantities passing, in the x direction, in unit time through unit area of a surface $x =$ constant and w is the convectional velocity. It is further shown that w is equal to the resultant flow of the partial molar volumes of the mixture. A diffusion coefficient defined in this way is independent of the properties (equation of state) of the mixture and of the relative proportions of the mixture. The three-dimensional diffusion of a mixture of several components is also treated. [See preceding Abstract.] R. W. P.

75. Rate of Diffusion in Metallic Crystals. W. Seith. *Zeits. f. Elektrochem.* **41.** *pp.* **872–876,** *Dec.,* **1935.**—From a consideration of results on the solubility of metals in solid Pb and of the rate of diffusion of the metals in Pb, it is observed that both the solubility and diffusion velocity depend in a regular manner on the position of the metal in the periodic table, *i.e.,* they depend on the atomic size and number of valency electrons. [See also Abstract 2730 (1934).] H. J. H. S.

76. Semipermeability and Neutral Salts. Ta-Yü Chang and Shou-Tsung Ch'iao. *Chinese Chem. Soc., J.* 3. *pp.* 308–320, *Nov.*, 1935. *In English.*—By the addition of increasing amounts of neutral salt to an acid dye (Congo red) sol, a collodion membrane is found to become at first permeable and then impermeable at points named, respectively, " permeable point " and " threshold value of coagulation." Different salts have different effects, but cannot be arranged in a lyotropic series. With the basic dye (neutral red, and methyl violet B) sols, the membrane becomes impermeable on the addition of any amount of salt; the point at which the membrane becomes just permeable is also studied by a continuous method. It is found semi-quantitatively that, on the addition of neutral salt, dehydration (examined by adding tannin and alcohol), discharging of a water layer in the pore-wall, and finally coagulation by salts, takes place simultaneously in the membrane and sol, thus rendering it permeable or impermeable. N. M. B.

See also Abstracts 32, 68, 249, 314, 326.

ELASTICITY AND PLASTICITY.

77. Flexural Centre of Closed Thin-Walled Sections. L. S. Leibenson. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 5. *pp.* 205–208, 1935. *In English.*—Since van der Neut's method for the determination of the position of the flexural centre of closed thin-walled sections sometimes gives inexact results another method is suggested, St. Venant being followed in the solution of the problem of flexure. For an approximate solution the method explained in an earlier paper for non-closed thin-walled sections can be applied. In the case of a compound contour, it is cut into simple contours and the same method is applied. R. S. R.

78. Bending of Thin Discs under Normal Thrust. B. Sen. *Phil. Mag.* 20. *pp.* 1158–1163, *Dec.*, 1935.—The problem of a thin circular plate bent by an arbitrary distribution of normal thrust is discussed. The following aspects of the problem are considered: a complete disc with a symmetrical distribution of load, a disc having a distribution of load varying as $\sqrt{b^2 - r^2}$ over a concentric circle of radius b, and a complete disc with an arbitrary distribution of load. H. J. H. S.

79. Elasticity Modulus of Copper-Beryllium Alloys. L. Guillet. *Comptes Rendus*, 201. *pp.* 960–961, *Nov.* 18, 1935.—The Rockwell hardness number and modulus of elasticity of Cu-Be alloys containing up to 20 % Be are determined. Be considerably increases the elasticity modulus of Cu (an alloy containing 15 % by weight of Be has a modulus equal to that of steel). The hardness increases linearly with the Be content. H. J. H. S.

80. Isotherms of CO_2 between 0° and 150° C. and Pressures from 16 to 250 Atmospheres. A. Michels and (Mrs.) C. Michels. *Roy. Soc., Proc.* 153*A*. *pp.* 201–214, *Dec.* 2, 1935.—By means of the apparatus previously used for N_2 [see Abstract 2734 (1934)] the isotherms of CO_2 have been determined between 0° and 150° C. for pressures ranging from 16 to 250 atmospheres (18 to 206 Amagat units). The results are tabulated and series equations are deduced to give pv. It is inferred that the specific heat at constant volume increases with increasing density. [See following Abstract.] R. W. P.

***81. Isotherms of CO_2 between 70 and 3000 Atmospheres. A. Michels, (Mrs.) C. Michels and H. Wouters.** *Roy. Soc., Proc.* 153*A*. *pp.* 214–224, *Dec.* 2, 1935.—For work at higher pressures [see preceding Abstract] a modified piezometer is used. A description is given of this instrument and of the method of filling it with gas. Results are determined for CO_2 at temperatures from 0° to 150° C. and pressures up to 3000 atmospheres (200 to 600 Amagat units). The specific heat at constant volume increases with increasing density to a maximum for a density of 226·7 Amagat units, coinciding with the density of the critical point, then decreases and passes through a minimum at a density of between 390 and 460 Amagat units. R. W. P.

82. Temperature Dependence of Plasticity. H. Ekstein. *Zeits. f. Krist.* 92. *pp.* 253–274, *Dec.,* 1935.—Previous researches on low melting metallic crystals have shown that plasticity is scarcely dependent upon temperature, although at very low temperatures (*e.g.,* 1·2° K.) an appreciable plasticity is developed. It is concluded therefore that plasticity is not a consequence of atomic movements and that its fundamental character is athermic. The present paper describes with full experimental details the thermal-plasticity behaviour of crystals of tungsten and rock-salt; the latter is in general accord with the above data and affords additional evidence that in crystals the fundamental plastic processes are of an athermic nature. The behaviour of amorphous bakelite is found to be in marked contrast to the above, and includes an extraordinary change in the initial plastic tension within the range of 16–60° C., which is in accord with the thermal theory of plasticity. H. H. Ho.

83. Plasticity of Crystals. Part IV. E. Orowan. *Zeits. f. Physik,* 97. 9–10. *pp.* 573–595, *Nov.* 12, 1935.—The dynamical view of slip put forward in a previous paper [see Abstract 3509 (1934)] is considered in greater detail. The dynamical concept, especially that due to Becker, leads to a simple explanation of the manner in which the yield point varies with temperature and rate of deformation; as an illustration, the deformation of a Zn crystal is described. These relations are not deducible on the static view of slip. The yield points are not influenced by the recovery process at room temperature but the recovery effect is markedly dependent on temperature over a certain temperature. In the case of Zn and Cd, the yield points are constant and independent of the rate of loading at and below 0° C. and above 100° C.; an explanation based on the dynamical theory is offered. The distinction between the static and dynamic view points is clearly brought out by a consideration of the effect of temperature on slip velocity and elastic creep in metals. H. J. H. S.

84. Effects of High Shearing Stress Combined with High Hydrostatic Pressure. P. W. Bridgman. *Phys. Rev.* 48. *pp.* 825–847, *Nov.* 15, 1935.—With mean hydrostatic pressures up to 50,000 kg./cm^2., the effect of shearing stresses up to the plastic flow point is investigated in thin discs confined between hardened steel parts mounted for subjecting to normal pressure and torque simultaneously. It is found that many normally stable substances become unstable and may detonate, and that combinations of substances normally inert to each other may be made to combine explosively. The shearing stress at the plastic flow point can be measured as a function of pressure, and, at 50,000 kg./cm^2. may rise to the order of 10 or more times its value at atmospheric pressure. Polymorphic transitions under these stresses may be detected by a break in the shearing stress-pressure curve. A number of new polymorphic transitions are found in the 57 elements examined. N. M. B.

85. Torsional Vibrations of Cylindrical Rods under Variable Forces. B. Sen. *Indian Phys.-Math. J.* 6. *pp.* 41–44, *Sept.*, 1935.—A mathematical solution is given of the general equation for torsional forced vibrations produced in cylindrical shafts by fluctuating torsional forces acting on them, the forces transmitted being functions of time. As an example, the variable torsional force F (r, z, t) is taken equal to $\tau r \cos\omega t$, where τ is a constant, so that the particular solutions are obtained without using Bessel's functions; the special case of resonance is noted. H. M. B.

See also Abstracts 116, 263, 264, 275.

GRAVITATION.

86. Gravity Determinations in Europe. P. Lejay. *Comptes Rendus*, 201. *pp.* 753–756, *Oct.* 28, 1935.—The periods of two pendulums are determined at 11 stations in Central Europe, and a new base station is established by observations with the pendulums at the Observatory of the Pic du Midi. W. A. R.

HYDRODYNAMICS AND AERODYNAMICS.

87. Flow through Submerged Orifices. J. Kunz. *Physics*, 6. *pp.* 351–355, *Nov.*, 1935.—From the measurements of F. E. Giesecke on the flow of liquids through submerged orifices two definite laws are deduced. When the diaphragm is completely closed, the liquid flows backwards along the wall of the tube, and forward in a central vein, the radius of which is calculated for laminar and turbulent flow. The theory by v. Kármán for turbulent flow is applied to a tube of circular cross-section. It is shown that both the backward flow and the jet issuing from the orifice are unstable. By an experiment it is made evident that a jet may sometimes describe a spiral motion. AUTHOR.

88. Study of Fluid Motion by Refraction Method. A. Magnan and C. Magnan. *Comptes Rendus*, 201. *pp.* 937–938, *Nov.* 18, 1935.—The mirror-method previously described [see Abstract 3335 (1933)] is applied to investigate the motion of fluid near a heated wire immersed in the fluid, (2) the melting of ice in water, and (3) the motion of water produced by the action of the fins of a swimming fish. J. S. G. T.

89. Continuity Equation in Hydrodynamics. F. v. Krbek. *Ann. d. Physik*, 24. 5. *pp.* 440–444, *Nov.*, 1935.—The customary deduction of the equation of continuity is considered unsatisfactory; a simpler deduction is proposed. It appears more natural to derive the stress tensor from a volume-force so that recourse to the so-called solidification hypothesis can be avoided. J. S. G. T.

See also Abstract 276.

KINETIC THEORY OF MATTER.

90. Brownian Motion of an Axially-Symmetrical Particle. G. A. Krutkow and I. I. Diner. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 6. *pp.* 243–246, 1935. *In German.*—In a previous paper [see Abstract 2390 (1935)], Krutkow has discussed the following problem: An axially symmetrical particle is, at time $t = o$, given component angular velocities p_0, q_0, r_0; determine the probability that at time

t the component angular velocities will have values between $p, p + dp$; $q, q + dq$; $r, r + dr$. Using the notation in which the probability is denoted by (dp, dq, dr), expressions are now derived for (dp, dq, dr) for a spherically symmetrical particle, for (dw, dr), (dp, dq), (dx), where $w^2 = p^2 + q^2$ and $x = p$ or q. Expressions are likewise derived for the most probable values of r^2, p^2, q^2 and the rotational energy. J. S. G. T.

91. Brownian Motion of a String. G. A. Krutkow. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 7. *pp.* 297–300, 1935. *In German.*—The Brownian motion of a stretched fibre is discussed mathematically. J. S. G. T.

See also Abstracts 110, 350.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 137.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

92. Combination of Observational Data. H. Levy and J. C. Gascoigne. *Phys. Soc., Proc.* 48. *pp.* 79–84, *Jan.* 1, 1936.—A method is devised for solving the following problem: Given m curves derived by m different experimenters to describe the same physical process, how are these to be combined into one unique curve? Formulæ are developed that enable the ordinates of the combined curve to be calculated simply from those of the constituent members. AUTHORS.

93. Electrical and Magnetic Magnitudes. E. Brylinski. *R.G.E.* 38. *pp.* 589–602, *Nov.* 2, 1935.—The existence of an independent theory of magnetism is due to the fact that magnetic phenomena were known before electrical phenomena had been investigated to any considerable extent. The author considers that magnetic theories, as distinct from electrical theories, should now be renounced, and particularly the similitudes that it has been attempted to establish between magnetic and electrical phenomena. The normal procedure is to define the magnetic magnitudes by means of the equation for $4\pi i$ and E. The dielectric constant of a vacuum is an electrical magnitude (otherwise all the electrical magnitudes would be purely mechanical); and the magnetic permeability of a vacuum should be considered as an electrical magnitude. A magnetomotive force is a physical magnitude of the same nature as an electric current, and a magnetic flux a magnitude of the same nature as a total e.m.f. integrated with respect to time. Until proof to the contrary is forthcoming, the magnetic permeability should be considered as a physical magnitude with dimensions. A dimensional coefficient is unnecessary in the formulæ expressing the m.m.f. of an electric current or the e.m.f. resulting from a change of magnetic flux, but it is required in the equation expressing Coulomb's law. R. E. N.

94. Dimensions of Electromagnetic Quantities. A. Sommerfeld. *Zeits. f. techn. Physik*, 16. 11. *pp.* 420–424; *Disc.*, 424–426, 1935; *Phys. Zeits.* 36. *pp.* 814–818; *Disc.*, 818–820, *Dec.* 1, 1935.—Electromagnetic quantities must not be defined solely by means of the three units of length, mass and time, but by means of these and a fourth unit, for which a unit of electric charge, *e.g.*, the coulomb, is recommended. In practice the unit of resistance can be used instead, as advocated by G. Giorgi, the coulomb being determined from it by Joule's law. Dielectric constant must be defined as the ratio of polarisation to electric force, a definition leading to rationalisation. The attempt to force all electromagnetic quantities into a 3-unit system gave rise to inconsistencies which, although consecrated by usage, must now disappear. Thus inductance can no more be identified with a length, and a henry is not an earth-quadrant. P. V.

See also Abstracts 98, 125, 143, 161, 335.

MECHANICS, CLASSICAL.

***95. Driving Pendulums. W. Meyer zur Capellen.** *Zeits. f. Instrumentenk.* 55. *pp.* 393–407, *Oct. and pp.* 437–448, *Nov.*, 1935.—The oscillation of a weighted plane under the influence of its weight describes conchoidal motions [see Abstract 2657 (1932)]. Since this conchoidal motion can be considered as a special case of the motion of a linked quadrangle, a consideration of the motion of such a quadrangle under special conditions is used to find the motion of the weighted plane. Simple examples of the results of the general theory are given and the method is applied to the physical pendulum. In the second part the result of surfaces rolling on one another and coupled by circular motions is considered. H. M. B.

See also Abstract 262.

MECHANICS, QUANTUM.

96. Derivation of the Pauli Form of the Laplacian Operator. H. Hermann. *Zeits. f. Physik*, 97. 9–10. *pp.* 667–668, *Nov.* 12, 1935.—If $P_x = (h/2\pi i)(y\partial/\partial z - z\partial/\partial y)$ it is shown how to obtain the expression for $\sum_{x.y.z.}(P_x)^2$ as a differential operator. G. C. McV.

97. Proof of the Planck-de Broglie Relation. W. Glaser. *Zeits. f. techn. Physik.* 16. 11. *pp.* 481–484, 1935. *Phys. Zeits.* 36. *pp.* 875–878, *Dec.* 1, 1935.—It is assumed that the connections between the energy or the momentum, respectively, of an electron " particle," and the corresponding frequency or wave-length of the electron " wave " are not affected by external forces acting on the electron. By considering the reflection of electrons at a fixed barrier in the light of this assumption, a proof of the relations $E = h\nu$ and $p = h/\lambda$ can be constructed. G. C. McV.

98. Variation Problems in Quantum Mechanics. A. Schuchowitzky. *Comptes Rendus (Doklady) de l'Acad. des Sciences*, 3. 4. *pp.* 161–164, 1935. *In German.*—The Ritzsche method, which is usually employed for the calculation of the energy of atomic systems, approximates to the eigenfunction stepwise, the operator remaining unchanged. Considerations, however, of a physical character suggest the possibility of operator approximations, especially since good results are not easy to obtain by the Ritzsche method due to terms occurring in the energy operator which render the necessary integrations much more difficult. In the present paper, a method is described for the solution of variation problems which enables a stepwise approximation to the operator and which overcomes mathematical difficulties systematically. H. H. Ho.

99. Statistical Disturbance Theory. Part I. Calculation of Disturbance in the Thomas-Fermi Theory without Exchange. P. Gombás. *Zeits. f. Physik*, 97. 9–10. *pp.* 633–654, *Nov.* 12, 1935.—A method for the calculation of atomic disturbance is developed within the frame of the Thomas-Fermi theory and without consideration of electronic exchange.

A simple expression is found for the electronic density in the disturbed atom, which permits an estimation of its electronic distribution. A simple formula is also derived for the disturbance energies of different orders. A comparison of the disturbance energy calculated by the statistical method for the first and second orders with that derived from the corresponding wave-mechanical formula leads throughout to satisfactory agreement. The results which have been derived for the neutral atom can be transferred to statistical ions. The formula for the disturbed electronic density is applied to the calculation of the dipole moment [see also Abstract 323 (1935)] which induces an external electrical field in atoms or ions. Formulæ are derived for approximations of any derived order. A comparison of the first approximation of the statistical formula for the induced dipole moment with the corresponding statistically interpreted wave mechanical formula indicates the good agreement of both results. Finally, possible extensions of the above data are discussed.
H. H. Ho.

See also Abstracts 7, 21, 333.

RELATIVITY AND ETHER.

See Abstracts 120, 333.

SOLUTION.

100. Solubilities of Nitrogen and Hydrogen in Water at High Pressures. I. R. Krichevsky and J. S. Kasarnovsky. *Am. Chem. Soc., J.* 57. *pp.* 2168–2171, *Nov.*, 1935.—A thermodynamical equation is given which allows the calculation of the solubility of slightly soluble gases in solvents with small vapour pressure. The deduced equation is verified in examples of solubilities of nitrogen and hydrogen in water at pressures up to 100 atmospheres and temperatures from 0 to 100°. Partial molal volumes of nitrogen and hydrogen in their water solutions are calculated. The possibility of calculation of the fugacity of gases on account of their solubility is shown. AUTHORS.

101. Solubility of Ammonium Oxalate in Water. A. E. Hill and E. F. Distler. *Am. Chem. Soc., J.* 57. *pp.* 2203–2204, *Nov.*, 1935.—The solubility of ammonium oxalate in water is determined from 0 to 100°; the solid phase is the monohydrate throughout the entire range; the average figures in "International Critical Tables" are distinctly too low at 0 and at 50°. AUTHORS.

See also Abstracts 36, 75, 111, 218.

SURFACE TENSION AND COHESION.

102. Theory of Surface Tension of Liquid Metals. D. V. Gogate and D. S. Kothari. *Phil. Mag.* 20. *pp.* 1136–1144, *Dec.*, 1935.—An electron theory of surface tension of liquid metals is given. The agreement between the observed and calculated values is satisfactory. AUTHORS.

103. Surface Tension of Potassium and Lithium Salts of Fatty Acids by the Ring Method. Part I. A. Lottermoser and E. Giese. *Kolloid Zeits.* 73. *pp.* 155–170, *Nov.*, 1935.—Poor reproducibility of surface tension measurements of soap solutions cannot be accounted for on the basis of the hydrolysing influences of atmospheric CO_2, but is due to adsorption at the liquid surface, at the boundary surface of the containing vessel, and at the ring. Each of these adsorption effects, especially the second, results in measured surface tensions higher than the true values. P. H. B.

104. Surface Tensions of Binary Liquid Mixtures containing Benzene. J. W. Belton. *Faraday Soc., Trans.* 31. *pp.* 1642–1648, *Dec.*, 1935.—The surface tensions of mixtures of benzene and (*a*) acetic acid, (*b*) carbon disulphide, (*c*) carbon tetrachloride, are measured and the surface adsorptions calculated from the Gibbs equation. In (*a*) and (*b*) the measurements are made at two temperatures. The form of the adsorption-composition curve and the application of the gas laws to the surface film is discussed. AUTHOR.

105. Surface Tensions of Ternary Solutions. Part III. J. W. Belton. *Faraday Soc., Trans.* 31. *pp.* 1648–1652, *Dec.*, 1935.—The surface tensions of solutions containing (*a*) sucrose and NaCl and (*b*) dilute HCl and NaCl and dilute HCl and KCl are measured and the surface adsorptions of water calculated. In the former the adsorptions are much less than the sum of the adsorptions each solute would produce separately. In the latter an amount of acid which has hardly any effect on the surface tension of water produces a marked effect on the adsorption of water on a salt solution. [For Parts I and II see Abstract 4491 (1935).] AUTHOR.

106. Surface Tension and Vapour Tension of Dipolar Liquids. J. J. Bikerman. *J. de Physique et le Radium*, 6. *pp.* 469–470, *Nov.*, 1935. —The author puts forward the hypothesis that so-called associated liquids possess dipolar molecules which orient themselves spontaneously at the liquid-vapour interface, and in this way he explains the more important anomalies shown by these liquids. The basis of the hypothesis is very similar to Debye's recent theory. P. H. B.

107. Monomolecular Films. Part II. *d*-Pimaric Acid and Tetrahydro-*d*-pimaric Acid. W. D. Harkins, H. E. Ries, Jr., and E. F. Carman. *Am. Chem. Soc., J.* 57. *pp.* 2224–2227, *Nov.*, 1935.—Surface potential and force-area relations for monomolecular films of a saturated and unsaturated pimaric acid are studied. The corresponding curves are shown. An improved procedure for obtaining more accurate clean-surface potentials is described. The maximum thickness of the mono-layer is about 12 Å for both compounds. The coefficients of compressibility are calculated. The structures of the pimaric acids are compared with that of cholesterol, and their orientations in surface films are related to the different positions in which the polar groups are located. The experimental data compare favourably with the results to be expected from model measurements. The surface potential of the tetrahydro-*d*-pimaric acid is about 200 mV., whereas that of the unsaturated compound is about 100 mV. An unprecedented decrease in the surface potential on compression was observed in the case of the unsaturated acid films. It is considered probable that these facts may be related to an increasing intramolecular dipole compensation on compression. [For Part I see Abstract 4880 (1935).] AUTHORS.

See also Abstract 4.

VACUA, HIGH.

***108. Low-Pressure Manometer. J. Niklibore.** *Acta Physica Polonica*, 4. 1–2. *pp.* 85–96, 1935. *In German.*—The manometer consists of a vibrating system comprising two quartz plates 10 × 20 mm. and about

0·1 mm. thick suspended on a quartz fibre and capable of torsional oscillation. Between the quartz plates is mounted a piece of electrolytic iron which enables oscillations to be started by means of a magnet. The observation consists in determining the half-value period (in seconds) of the amplitude of the oscillations. Curves are given illustrating the behaviour of the manometer over the pressure range from 10^{-1} to 2×10^{-3} mm. of mercury, the half-value times being of the order of 20 and 300 sec. respectively and dependent of course on the gas. G. E. B.

***109. Knudsen Vacuum Gauge for Large Metal Systems. J. W. M. DuMond and W. M. Pickels, Jr.** *Rev. Sci. Instruments,* 6. *pp.* 362–370, *Nov.,* 1935.—The McCleod, Pirani, Knudsen and ionisation gauges are studied as to their suitability in the operation of large metal vacuum systems with organic vapour pumps now coming into extensive use in modern physics. Advantages and disadvantages of each type based on experience are critically discussed. The superiority of a gauge on the Knudsen principle for this work is stressed and a new design is presented and a simpler mode of operation of such a gauge together with a full discussion of its construction, calibration and characteristics. AUTHORS.

***110. Ionisation Gauge for the Detection of Molecular Rays. M. J. Copley, T. E. Phipps and J. Glasser.** *Rev. Sci. Instruments,* 6. *p.* 371, *Nov.,* 1935.—The essential features of the gauge are (1) its small volume of only 3 c.c., (2) its high sensitivity of 0·191 A. per mm. of Hg, (3) a highly insulated plate, and (4) the use of a thin metal film on the wall for a plate, permitting simultaneous outgassing of wall and plate by radiation from the grid. F. C. C.

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111. Absorption of Gases by Mercury. S. Ptizin. *Techn. Phys. U.S.S.R.* 2. 1. *pp.* 66–78, 1935. *In English.*—The absorption of gases, whether air or organic vapours, is studied, and the question of freeing Hg from absorbed gases also receives attention. It is shown that Hg distilled in a vacuum gives off but little air, 130 mm^3. of Hg giving off only 0·5 mm^3. of gas measured at 1 mm. pressure, even after being stored for some time open to the air while cleaned mercury only absorbs atmospheric gases for a few hours. It was also shown that much of the gas liberated comes from the decomposition of organic compounds absorbed in the Hg. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

112. Viscous Properties of Polyisobutylene. J. D. Ferry and G. S. Parks. *Physics.* 6. *pp.* 356–362, *Nov.,* 1935.—The viscosity of polyisobutylene (molecular weight about 4900) is studied from 70° C. to 175° C. with a falling sphere viscometer and from — 53° C. to 24° C. with a concentric cylinder viscometer. In the measurements with the latter apparatus, elastico-viscous effects appear, and the viscous behaviour is non-Newtonian. The apparent viscosities are accordingly extrapolated to zero torque to give values for the viscosity at zero shear. The viscosity ranges from 19 poises at 175° C. to 10^{10} poises at — 53° C., showing a rather low temperature coefficient. At — 76° C., the midpoint of the " transition region " for polyisobutylene glass, the viscosity has an extrapolated value of about 10^{13} poises, in agreement with a general rule for glass-forming materials. Macroscopic and microscopic interpretations of viscosity anomalies are discussed. AUTHORS.

113. Viscosity of Solutions of Salts in Methanol. G. Jones and H. J. Fornwalt. *Am. Chem. Soc., J.* 57. *pp.* 2041–2045, *Nov.*, 1935. —The absolute density and relative viscosity at 25° of many solutions of KCl, KBr, KI, and NH_4Cl in methanol are measured covering a range of concentration from extreme dilution nearly to saturation. The density of solutions of these salts in methanol may be expressed by an equation of the form suggested by Root for aqueous solutions. Although all of these salts may cause a decrease in viscosity when dissolved in water, none of them shows this effect when dissolved in methanol. All of these solutions show the Grüneisen effect strongly. The data are used to test the validity of several equations for the viscosity as a function of the concentration.
AUTHORS.

114. Viscosity of Liquid Phosphorus. A. N. Campbell and S. Katz. *Am. Chem. Soc., J.* 57. *pp.* 2051–2055, *Nov.*, 1935.—Experiments are carried out on the effect of rapid chilling on the viscosity of phosphorus. The viscosity of liquid phosphorus is determined between the temperature limits 20–140°. The agreement with the prior figures of Dobinski (range 17·5–79·9°) is very good. As most of this work was carried out in ignorance of the very recent work of Dobinski [see Abstract 137 (1935)] it appears that the viscosity of phosphorus is now known with a satisfactory degree of accuracy, at least over the temperature range common to both. Association becomes appreciable in liquid phosphorus below 45°. The bearing of this and of the chilling experiments on Smits' theory is discussed.
AUTHORS.

115. Viscosity of Liquid Tin. A. J. Lewis. *Phys. Soc., Proc.* 48. *pp.* 102–110, *Jan.* 1, 1936.—By the capillary-flow method the viscosity of liquid tin is measured over a range of temperature just above the melting-point. The kinetic-energy correction is determined independently by the use of Knibbs' graphical method. The viscosity values are in good agreement with the measurements of Stott, and confirm the general accuracy of the work of Sauerwald and Töpler. The temperature variation of the viscosity and the value at the freezing-point can be adequately represented by Andrade's theory of the viscosity of liquids.
AUTHOR.

116. Compressional Waves in Media with Complex Viscosity. A. Gemant. *Physics,* 6. *pp.* 363–365, *Nov.*, 1935.—The author recently suggested [see Abstract 4889 (1935)] the introduction of a complex viscosity in the theory of vibrations of materials which lie between the purely crystalline and the liquid state. This conception is utilised here in the theory of compressional waves in an infinite medium. One of the conclusions, namely, the decrease of the attenuation factor with increasing frequency, is in agreement with observations. Another conclusion is an increase of the propagation velocity with frequency. Both changes occur in the neighbourhood of a certain characteristic frequency, given by the reciprocal of the so-called relaxation constant. Below this frequency range the material vibrates like a liquid ; above this range like a crystal. AUTHOR.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

117. Elements and Ephemeris for Comet 1933f (Whipple). G. C. Cilliė and W. A. Johnson. *Harvard Coll. Obs., Circ. No.* 409 [10 *pp.*], 1935.—This comet was discovered in October, 1933, and the latest recorded observations are those of January 31, 1935. It is specially interesting because of the low eccentricity of its orbit. Using all available observations, an ephemeris has been computed for Oct. 5, 1935, to May 12, 1936. The brightness at opposition early in March, 1936, will be about 19m. 5. It is hoped that attempts will be made to observe it. M. A. E.

COSMOGONY.

118. Redshift from Nebulæ. F. Zwicky. *Phys. Rev.* 48. *pp.* 802–806, *Nov.* 15, 1935.—Some critical considerations are advanced, concerning the theory of the expansion of the universe. The main purpose of this paper is to indicate how a statistical theory can be developed which makes it possible to discuss in a very general way a number of features of the redshift of light through intergalactic space. In particular the problem of the width of spectral lines from distant nebulæ is treated. Finally some observational tests are proposed which promise to throw new light on the problem of the redshift. AUTHOR.

119. Motion of Free Particles in Milne's Model of the Universe. T. Lewis. *Phil. Mag.* 20. *pp.* 1092–1104, *Dec.*, 1935.—It is shown that the integrated form of the acceleration of free particles in Milne's kinematical model of the universe can be obtained in simple form directly from the cosmological principle, without recourse to the integration of Milne's differential equations. It also follows that Milne's argument showing that the quantity $1 + G(\xi)$ must always be negative for finite ξ is false. It also follows that, for an accelerated particle passing near, with small velocity, to a fundamental particle, the parameter $G(\xi)$ must vanish at the point where the accelerated and fundamental particles are closest together.
G. C. McV.

120. New Solutions of the Differential Equation for Isotropy. V. V. Narlikar and D. N. Moghe. *Phil. Mag.* 20. *pp.* 1104–1108, *Dec.*, 1935.—Five new solutions of the general equation for isotropy for the matter filling an expanding universe are given. The solutions allow of a radial flow of matter outwards from a point relative to the coordinate system used. G. C. McV.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

121. Motion of *n* Points with Variable Masses Attracting Each Other according to the Inverse p^{th} Power of Their Distances Apart. M. Mendes. *Bull. Astronomique*, 9. 3. *pp.* 169–176, 1934.—The masses of the particles are supposed to vary with the time. Some properties of the solutions of the equations of motion are found and comparison is made with the case of particles of fixed masses. G. C. McV.

NEBULÆ.

See Abstracts 118, 126.

STARS.

122. Microphotometric Measurement of Stellar Magnitudes. S. P. Liau. *Rev. d'Optique*, 14. *pp.* 305–316, *Sept.*, 1935.—The stellar images on the photographic plate are illuminated by a circle of light whose diameter is slightly larger than that of the image of the brightest star to be measured, and the " mean density " of the illuminated area measured. A calibration curve is obtained by plotting against magnitudes the " mean densities " so obtained for various stars of known magnitudes on the plate. The magnitude of a star of unknown brightness can then be determined to 0·02 or 0·03. The correction to be applied for star images not situated near the centre of the plate is determined, and shown to be less than those necessary in the determination of magnitudes by the method of measuring the diameters of stellar images. Results of the application of the method to the determination of the brightness of a variable star (GO Cygni) are given. D. H. F.

123. Radius-Temperature Relation in Cepheids. A. E. H. Bleksley. *Zeits. f. Astrophysik*, 11. *pp.* 59–70, *Nov.* 17, 1935. *In English.*—The relation between photospheric radius (r) and temperature (ϑ) of a number of Cepheid variables, particularly of RS Boötis, is studied by utilising visual and photographic light curves. It is found from RS Boötis that radius and temperature differ in phase by 180°, and it is further shown by this and other material that the variations in r and ϑ are such as to satisfy the relation $r\,\vartheta = \text{constant}$. The bearing of these results on the Milne diagram is discussed, as also some theoretical points in this connection, raised by Milne. AUTHOR.

124. Colour Temperatures of Stars. D. Barbier. *Comptes Rendus*, 201. *pp.* 943–945, *Nov.* 18, 1935.—The numerous available measures are for bright stars and Pleiades relative to sources whose temperatures are ill defined or entirely arbitrary. If reduced to a uniform system (that of Greaves, Davidson and Martin) they yield a catalogue of 367 bright stars and 57 Pleiades. The colour temperatures obtained for the various spectral types are tabulated; they range from 21,000 (in B_3, B_5) to 3600 (in gM). The measures for stars near A_0 show the best mutual agreement; they may be used as secondary standards. The differences between the mean colour temperatures and the ionisation temperatures for the various spectral types have roughly the same trend as the Balmer-line intensities; *i.e.*, small at B_0–B_5, increasing to a maximum at A_0A_5 and becoming small again beyond F_5. Satisfactory agreement between colour temperatures and temperatures obtained by Mohler from Zanstra's theory verifies that the theory is valid and that the stellar radiations differ little from black-body. New colour-temperature measurements now in progress will yield a less provisional catalogue. W. J.

125. Nomographical Representation of Saha's Equation. A. Unsöld. *Zeits. f. techn. Physik*, 16. 11. *pp.* 460–461, 1935. *Phys. Zeits.* 36. *pp.* 854–855, *Dec.* 1, 1935.—The calculation of the thermal degree of ionisation by Saha's formula may be considerably simplified by application of a nomogram which permits a reading of the equilibrium constants as a function of the absolute temperature and the ionisation potential. A numerical example is given. J. E. K.

126. Globular Cluster NGC 2419. W. Baade. *Mt. Wilson Observat. Contrib. No.* 529. *Astrophys. J.* 82. *pp.* 396–412, *Dec.*, 1935.—Owing to its unusally large distance and its position in the anticentre region of our galaxy, the globular cluster NGC 2419 is of exceptional interest. The discovery in the cluster of 36 variable stars, 31 of which are short-period Cepheids, made it possible to obtain a reliable determination of the distance modulus. The result is $m - M = 19 \cdot 24 \pm 0 \cdot 01$, which agrees closely with the value 19·17 derived from the 25 brightest cluster-stars. Counts of nebulæ in the surrounding field and the absence of selective absorption in the light of NGC 2419 indicate that the field of the cluster is free from local obscuration. The photometric distance must, however, be corrected for the general absorption within our galaxy (latitude effect), which reduces the measured modulus from 19·22 to 18·75 mag., corresponding to a distance of 56,000 parsecs. The question whether NGC 2419 is a member of our galaxy or an independent system is discussed. AUTHOR.

127. Early Spectrum of Nova Aquilae 1918. A. R. Sayer. *Harvard Coll. Obs., Circ. No.* 406. [22 *pp.*], 1935.—Much interest having lately arisen regarding the relation between intensities and radial velocities in the emission bands of Nova and Wolf Rayet spectra, quantitative determinations are made of these for the early stages of Nova Aquilæ 1918 (June 10–July 5), and structural variations are found which indicate an asymmetrical ejection of nebulous matter. From absorption line data, maximal and minimal numbers of atoms in the second quantum state of hydrogen are computed, and it is found that these lines are formed in the outer portions of the nebulous shell. The material of this shell is of higher density than that of the planetary nebulæ. M. A. E.

128. Intensity Distribution in Spectrum of Eclipsing Variable U Herculis. W. Krat. *Zeits. f. Astrophysik*, 11. *pp.* 71–75, *Nov.* 17, 1935.—In this system the dimensions of the two components are large compared with those of the orbit, and therefore the coefficients of reflection and apparent ellipticity can be precisely determined. The intensity of the continuous spectrum has been studied on 222 plates taken with an objective prism camera, and light-curves have been constructed from four different wave-lengths. It is clear that the apparent ellipticity of the components and the reflection effect are correlated with wave-length. The true ellipticity has also been determined. The temperature of the secondary star is much lower than that of the primary, therefore the type must be later. M. A. E.

129. Ultra-Violet Spectrum of Nova Herculis. B. Meyermann and P. Wellmann. *Zeits. f. Astrophysik*, 11. *pp.* 76–87, *Nov.* 17, 1935.—Three spectra of this star, taken on Dec. 21, 1934, Jan. 30 and Mar. 12, 1935, with the quartz spectrograph of Göttingen Observatory, have been studied at Göttingen and Potsdam independently, and the absorption lines have been measured. The joint results are given in tabular form, showing wave-length, intensity and character, identification, and comparison with the same lines in α Cygni and in the laboratory. M. A. E.

130. Spectrum of Nova Herculis, 5150–6550 Å. P. W. Merrill. *Mt. Wilson Observat., Contrib. No.* 530. *Astrophys. J.* 82. *pp.* 413–431, *Dec.*, 1935.—Of the absorption lines, special attention is paid to the

D lines of Na; and those of OI, Si II, Sc II, Ti II, Fe II, and Ba II also are systematically measured. One group of lines, called component I, has a displacement of − 180 km./sec.; another, called component II, of − 280 increasing to − 395 km./sec. Of the emission lines, those of Fe II, O I, Si II, Na I, and H, associated with component I, are of the P Cygni type, and are not very intense; but those associated with component II become much more intense and finally very unsymmetrical with the violet maximum the stronger. The chief facts concerning widths and displacements of both emission and absorption lines appear favourable to the hypothesis of an expanding atmosphere, though many details are puzzling. The comparative behaviour of lines Fe II and O I may largely be explained by the inability of atoms in front of the star to produce forbidden lines in absorption. On this interpretation, the radial velocity of the star as a whole is − 4 km./sec., and the shell has a radius about twice that of the photosphere. The expanding atmosphere may arise from an explosion driving off matter in a quasi-liquid state from which gaseous atoms later evaporate. M. A. E.

131. Light Changes of RY Urs. Maj. R. Müller. *Zeits. f. Astrophysik*, 11. *pp.* 88–92, *Nov.* 17, 1935.—This preliminary note calls attention to a short-period variation of 41·42 days and $0^{m}\cdot14$ amplitude superposed on the known long period (308 d.) of this Mira-type variable. It is an unusual feature, and suggests the possibility of an eclipse. The star is also peculiar in that the light is redder at maximum than at minimum. Further observation is very desirable. M. A. E.

See also Abstract 182.

SUN.

132. Distribution of Centres of Attraction for Prominences. P. C. Keenan. *Astrophys. J.* 82. *pp.* 369–376, *Dec.*, 1935.—Measurement on Yerkes spectroheliograms, of the heliographic latitudes of centres of influence for prominences shows that such centres are largely confined to the sunspot zones. They exhibit a marked correlation with individual spots, though some centres are formed in regions entirely free from sunspots. The zone of maximum frequency of occurrence of centres of attraction extends from the middle of a spot to slightly beyond the penumbra. The centres themselves have diameters ranging from the limit of resolution up to 25,000 km., and they commonly attract prominences as far away as 50,000–200,000 km. For thirty-nine streamers the average mass velocity was measured as 51 km./sec. Double streamers were found in 89 prominences. AUTHOR.

133. Intensity Measurements of the 2P–nD Series for Magnesium in the Solar Spectrum. M. Minnaert and J. Genard. *Zeits. f. Astrophysik*, 10. *pp.* 377–381, *Oct.* 18, 1935.—The intensities of seven lines of this series ($n = 3, 4, 5, 7, 9, 10, 11, 12$) are measured and the transition probabilities computed. The latter are found to be approximately constant, a result which is not at present satisfactorily explicable theoretically. G. C. McV.

See also Abstract 181.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

134. Conducting Laminæ in Periodic Magnetic Fields. J. McG. Bruckshaw. *Phys. Soc., Proc.* 48. *pp.* 63–73, *Jan.* 1, 1936.—The secondary magnetic field due to conducting circular discs, placed in a spatially uniform magnetic field which alternates with time, is measured and it is found that as the dimensions of the disc, the conductivity, and the frequency increase, the secondary field also increases and the phase-difference between the secondary field and the primary field changes from $\pi/2$ to 0. Simple considerations show that these features appear for all conductors or conducting laminæ of similar shape no matter how they are excited. The results are applied to the practical case of the location of good-conducting mineral lodes beneath the earth's surface. AUTHOR.

135. Seismic Prospecting with Reflected Waves. E. Koridalin and S. Masarskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 3. *pp.* 121–124, 1935. *In German.*—It is shown that the method of reflected waves is generally useful for geological prospecting, even in ground very difficult from the geological point of view. W. A. R.

HYDROSPHERE, PHYSICS OF THE.

136. Seasonal Changes in Components of Submarine Daylight. E. A. Williams and C. L. Utterback. *J.O.S.A.* 25. *pp.* 384–387, *Dec.*, 1935.—Measurements of the vertical absorption coefficients, and their seasonal variations, of several spectral bands of visible light are made at two selected stations. One station is located in the Strait of Juan de Fuca near Cape Flattery and the other in Hood Canal near its junction with Puget Sound. Variations are found at both stations which indicate some evidence of correlation between the growth of microscopic life and the penetration of daylight into these waters. AUTHORS.

***137. Dorsey Fathometer. H. G. Dorsey.** *Washington Acad. Sci., J.* 25. *pp.* 469–476, *Nov.* 15, 1935.—Describes an instrument of high precision designed primarily for sounding shoal water of depths less than 20 fathoms. The method employed is that of echo-sounding, in which the signal is started photoelectrically and the time interval is measured by a valve-driven tuning fork, operating at a frequency of 1025 ∼, associated with a synchronous motor having a speed of 20·5 r.p.s. On the same shaft with the rotor is a disc having a short radial slit and behind this is a circular neon tube which illuminates the slit when it is momentarily excited at the instants of sending and receiving the sounding signal. Positions of the illuminated slit are read directly against a circular glass scale divided to 0·2 in., corresponding to 1 ft. of depth, and tenths of a foot of depth may be estimated. The instrument is sensitive to small differences in depth caused by the rising and falling of a small surveying ship on a light swell. H. B.

LAND, PHYSICS OF THE.

138. The Living Globe. B. Willis. *Science,* 82. *pp.* 427–433, *Nov.* 8, 1935.—The effects of radioactive heating in the earth are rediscussed. The author points out that the usual assumption that radioactive elements are uniformly distributed either near the surface or in some postulated shell of the earth is unreasonable. Any theory of the origin of the earth seems to involve the deposition of the heavier elements, *i.e.*, metals, at the core. One must expect therefore that a considerable proportion of the heavy radioactive elements are also concentrated there. The heat produced by their disintegration has gradually melted the centre giving the " inelastic core." And if these elements are not now exhausted by disintegration the earth may be gradually melting from within outwards. The outer stratification of the earth is not easy to account for, but some of the phenomena at least may have been produced by local melting under the influence of heat generated by patchy distribution of radioactive material in the crust. W. A. R.

139. Water-Content of Soil. F. Obaton. *Comptes Rendus,* 201. *pp.* 845–846, *Nov.* 4, 1935.—The soil is compressed in an ebonite tube and its electrical resistance measured by a.c. of 800 ∼ using a bridge and telephones. By comparison with the drying method, a hyperbolic curve is plotted showing the relationship of resistance to water-content for a sandy soil. Other experiments show that soil containing much colloid does not give the same relationship. R. F. A.

METEOROLOGY.

140. Visual Spectroscopy of Atmospheric Ozone. J. Gauzit. *Ann. de Physique,* 4. *pp.* 450–532, *Nov.,* 1935.—The atmospheric ozone has been studied by observation of the Chappuis absorption bands by means of a visual spectrophotometer. Observations have been made by viewing the sun directly and by spectrophotometry of the light from the sky. Nocturnal observations have also been made by viewing the moon. Observations on the sun at the horizon have shown directly inequalities in the concentration of ozone in different parts of the same layer. A large number of measurements give values for the height of the ozone layer lying between 20 and 50 km., if the " thin layer " hypothesis is accepted, and indicate that the height of the layer increases with its thickness. Measurements on the sun when it is very low in the sky show, however, that the hypothesis is untenable, and give an approximate value for the amount of ozone in the troposphere. D. H. F.

141. Adsorption of Radon on Dust Particles. G. Rosa. *Gerlands Beitr. z. Geophys.* 45. 3. *pp.* 277–279, 1935.—A series of 33 experiments is described showing that, within limits of error, radon is not adsorbed on dust particles or nuclei. [See Abstract 2923 (1935).] C. A. S.

142. Change of Wind with Elevation in Curved Air Currents. B. Haurwitz. *Gerlands Beitr. z. Geophys.* 45. 3. *pp.* 243–267, 1935. *In English.*—A mathematical theory is given to estimate the change of velocity of wind with elevation in curved isobars. An exact solution can be made if the velocity is considered proportional to the distance from the centre, the coefficient of eddy viscosity constant and the pressure gradient independent of the height. If these conditions are not fulfilled it is more convenient to use approximation methods, which are indicated and which compare favourably with more exact methods as shown by a diagram. Numerical examples show that the gradient wind direction and velocity are reached at lower heights in cyclones and greater height in anticyclones than in straight isobars; this must be due to change in pressure gradient with elevation. H. M. B.

143. Test of Value of a Particular Period in Forecasting. S. R. Savur. *Indian Acad. Sci., Proc. 2A. pp.* 336–341, *Oct.,* 1935.—A simple method of testing whether a particular period is of use in forecasting is explained. The method is first tested on artificial sets of data in two of which random variations are superposed upon a periodic variation, and in the remaining three there are no periodicities at all. In the former case the periodicity tested is found to be significant, while in the latter the periodicity is not significant. When the same method is applied to see whether the 23-year period, suggested by C. G. Abbot, is of use in forecasting annual rainfall at Madras and Nagpur, it is found that the period is not of use. AUTHOR.

***144. Humidity Control at High Temperatures. W. Lethersich.** *Journ. Sci. Instruments,* 12. *pp.* 388–391, *Dec.,* 1935.—The usual method of controlling humidity in ovens does not enable high humidities to be obtained at temperatures up to 100° C., and, although this may be accomplished by means of special apparatus, it has been found difficult to maintain humidities from 90 to 100 % at high temperatures over long periods within limits of 1 %. The method described is a simple one which allows a control of any humidity at temperatures up to 100° C. to be readily obtained. AUTHORS.

SEISMOLOGY.

145. Seismic Waves. Part II. B. Gutenberg and C. F. Richter. *Gerlands Beitr. z. Geophys.* 45. 3. *pp.* 280–360, 1935. *In English.*—Results are based on records of 185 earthquakes. Beyond 2000 km. focal distance the dominant periods of the waves considered (P, S, P′, PP, SS) show no further increase. The geographical distribution of shocks exhibiting initial compression or dilatation is the same for normal and deep focus quakes. The amplitude ratios of two phases, especially PP/P, depending essentially on the wave velocity at the place of reflection, imply continental crust of thickness not small compared with a wave of 20 km. under the Atlantic and Indian Oceans, and south of the Galapagos Ids., and sporadically below the Polar basin; elsewhere the Pacific type is indicated. The appearance of the various phases in seismograms is discussed. Records of P and S waves at small focal distances imply that from about 100 km. depth the velocity in the mantle increases continuously with depth, with no marked discontinuity until the core is reached at 2920 ± 25 km. Previous determinations of velocities within the core are confirmed, with no indication of any further discontinuities. The Poisson ratio in the mantle is a minimum (0·26) at 1000 km. and a maximum (0·30) below 2500 km. [For Part I see Abstract 655 (1935).] C. A. S.

146. Recent Advances in Seismology. F. J. W. Whipple. *Nature,* 136. *pp.* 782–784, *Nov.* 16, 1935. *Paper read before the British Assoc., Sept.,* 1935.—After referring to Jeffreys' and Bullen's revised travel-time tables, the occurrence of earthquakes with deep foci (up to 400 km.) is discussed, and their distribution across Japan shown, whence the existence of faults extending to similar depths is inferred. [See Abstract 659 (1935).] C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

147. Progressive Lightning. Part II. B. F. J. Schonland, D. J. Malan and H. Collens. *Roy. Soc., Proc.* **152*A*.** *pp.* **595–625,** *Nov.* 15, 1935.—This paper is a continuation of previous work [see Abstract 1066 (1934)]. From an examination of 95 flashes a statistical study is made of the distribution of the strokes of a discharge. The leader-return stroke sequence is present in almost all cases. Leaders to first strokes are stepped, but to subsequent strokes generally dart-like. Mean values are given for the velocities of the three types of development, stepped-leaders, dart-leaders and main return strokes. The downward branching of lightning is shown to arise from the stepped-leader process. In an examination of the nature of the stepped-leader the authors find a value of the velocity of the streamers making up the steps, of the order of 5×10^9 cm./sec.; and the range in variation of the time intervals between the steps to be small compared with that of the step-lengths. It is further inferred that the leader process lowers into the air a large fraction of the cloud charge tapped. A study of the return stroke indicates a diminution in intensity generally as branch points are passed. Discharges into the air exhibit no return stroke. The paper is illustrated by photographs and diagrams. [See also *Nature,* **136.** *p.* **831,** *Nov.* **23, 1935.**] A. E. M. G.

148. Intermittent Lightning Discharges: Rediscussion of Hoffert's Lightning Photograph. B. Walter. *Phil. Mag.* **20.** *pp.* **1144–1155,** *Dec.,* 1935.—Hoffert's photograph of a lightning flash taken with a hand moved camera [see *Phil. Mag.* **28.** *p.* **106,** 1889)] is reexamined, and a revised order of the flashes proposed, supporting the author's view that in a multiple flash the channel of the flash may be shifted for one or more discharges, and then returned to by subsequent discharges. There is also some evidence in support of Schonland and Collens' theory of the leader stroke. [See Abstract 1066 (1934).] C. A. S.

RADIOACTIVITY.

149. Half-Life Period of Radium E. (Miss) A. Pompéi. *J. de Physique et le Radium*, 6. *pp.* 471–472, *Nov.*, 1935.—The half-life period of Ra E, determined by I. Curie and Chamié's compensation method [see Abstract 878 (1925)] is 5·02 ± 0·01 days. C. A. S.

150. Action of Radon on Polymethylenes. G. B. Heisig. *J. Phys. Chem.* 39. *pp.* 1067–1073, *Nov.*, 1935.—Pure cyclopentane and cyclopentene are prepared and the vapour pressures determined at several temperatures. The action of radon on these compounds is studied. The $-M/N$ values are in agreement with the heats of formation and with $\Delta(H_2 + CH_4)100 / - \Delta HC$. [See Abstract 3463 (1933).] AUTHOR.

151. Reduction of Ferric Chloride by α-, β- and γ-Rays. G. W. Spicer. *Faraday Soc., Trans.* 31. *pp.* 1706–1710, *Dec.*, 1935.—The following cases of the irradiation of ferric chloride are studied:—Using α-rays (*a*) aqueous ferric chloride solution, (*b*) anhydrous ethereal solution, (*c*) solid anhydrous ferric chloride. Using β- and γ-rays (*d*) aqueous ferric chloride solution, (*e*) anhydrous ethereal solution. Complete reduction is found to occur in the instances of (*a*), (*b*) and (*e*). In case (*c*), although reduction occurs it is apparently incomplete, a yield of chlorine of 1·002 mg. being obtained out of a possible total of 3·66 mg. In this case, too, it is possible that reduction may be complete in the thin layer through which the α-rays penetrate. In case (*d*) no reduction can be detected, and this is, therefore, the only exception to reduction in the series studied. AUTHORS.

152. Registration of the Ionisation Curve of a Single α-Particle. H. Alfvén. *Zeits. f. Physik*, 97. 11–12. *pp.* 718–724, *Nov.* 25, 1935.—The track of ions which is produced by an α-particle moves in a homogeneous electric field with constant velocity. The whole ionic track can thus be brought progressively into a discharge chamber, where it produces a current which gives the ionisation curve. The current which is of the order of magnitude 10^{-13} A is by a specially constructed amplifier [see Abstract 292 (1936)] so much amplified that it can be oscillographed. The oscillograms thus obtained give a good picture of the ionisation curve. The method can perhaps be useful in the study of nuclear reactions.

J. J. S.

***153. Deflection of α-Particles. R. Mercier and P. Scherrer.** *Helv. Phys. Acta*, 8. 7. *pp.* 589–590, 1935. *In French.*—A brief description of apparatus for demonstrating the deflection of α-particles by nuclei.

W. E. P.

154. Absorption Coefficients of Hard γ-Rays. W. Gentner. *Zeits. f. techn. Physik*, 16. 11. *pp.* 416–418, 1935. *Phys. Zeits.* 36. *pp.* 810–812, *Dec.* 1, 1935.—Measurements were made of the change in the absorption coefficients for hard-γ-rays of different wave-lengths in Pb and of the variation of the absorption coefficient for the hard γ-ray, $h\nu = 2{\cdot}65$ MV, from ThC″ with absorbers of different atomic number. In both cases good agreement was obtained with existing theory in terms of the three absorption processes involving the photoelectric effect, Compton effect and pair formation. F. C. C.

See also **Abstracts 138, 141, 159, 175, 289, 292.**

RADIATION.

COLORIMETRY.

155. Maximum Visual Efficiency of Coloured Materials. D. L. MacAdam. *J.O.S.A.* 25. *pp.* 361–367, *Nov.*, 1935.—Tristimulus values are computed for hypothetical spectrophotometric curves of the type found to give the maximum visual reflectance factor (or transmission factor) for specified chromaticities. These computations are based on the I.C.I. 1931 data for the normal observer for colorimetry, and on the I.C.I. illuminants "A" and "C." By plotting the results on the I.C.I. colour mixture diagram, the loci of points characterised by equal maximum efficiencies are established. Tables are prepared showing the maximum visual efficiency as a function of excitation purity for 24 dominant wavelengths. AUTHOR.

156. Discrimination of the Saturation of Colours. F. L. Warburton. *Phys. Soc., Proc.* 48. *pp.* 38–48, *Jan.* 1, 1936.—Recent data on the sensitivity to saturation-differences are correlated with the complementary colour-mixture data for the same observer. The experimental results are discussed on the basis of the three-component theory of Young and Helmholtz, and an attempt is made to explain them by applying Weber's law to the component colours of the theory. AUTHOR.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

157. Magnetic Birefringence of Nitric Oxide. H. Bizette and T. Belling. *Comptes Rendus*, 201. *pp.* 955–956, *Nov.* 18, 1935.—The Cotton-Mouton constant, C_m, of NO for λ 5780 is 456×10^{-15} at 16·5° and under 143 kg./cm^2, pressure ; it varies directly as the density. The birefringence varies inversely as λ. [See Abstract 2840 (1934).] C. A. S.

See also Abstract 355.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

158. Luminescence of Frozen Dye Solutions. Frances G. Wick and Charlotte G. Throop. *J.O.S.A.* 25. *pp.* 368–374, *Nov.*, 1935.—The luminescence of organic dyes in solution shows marked changes in intensity as the solutions are cooled to the temperature of liquid air. The changes observed take place at those temperatures at which the physical state of the solvent also changes. A. H.

159. Stability of Lenard Luminescence Points in Zinc Sulphide. N. Riehl. *Ann. d. Physik*, 24. 6. *pp.* 536–542, *Nov.*, 1935.—It is shown that the excitability of ZnS by α-rays exhibits a spontaneous falling-off with time. The percentage decrease is highest in the case of ZnS which is most strongly excited by α-rays. The luminescent centre thus exhibits in certain cases, particularly with rapidly cooled phosphors, a thermodynamically unstable structure. J. E. B.

160. Oxygen Afterglow. E. M. Stoddart. *Roy. Soc., Proc.* 153*A. pp.* 152–157, *Dec.* 2, 1935.—It is shown that many of Lord Rayleigh's criticisms of the author's paper [see Abstract 2509 (1935)] are untenable. A survey of observations concerning the oxygen afterglow is given, and the author's earlier conclusions are justified. Experiments are described showing the effect on the oxygen afterglow of water vapour in the gas phase and adsorbed on the surfaces of the vessels. These observations are in agreement with the results of other workers. AUTHOR.

See also Abstract 207.

INTERFERENCE. DIFFRACTION AND SCATTERING.

***161. Nomogram for Calculation of Fractional Values of Interference Fringes. A. I. Kartacheff.** *Rev. d'Optique,* 14. *pp.* 328–331, *Sept.,* 1935.—A nomogram is described for the graphical determination of the value of the expression $(d_2^2 - d_1^2)/d_2^2$, where d_2, d_1 are the diameters of successive rings [see Abstract 4170 (1931)], for the fractional part of the order of interference of rings in the pattern produced by a pair of parallel semi-transparent reflecting surfaces illuminated by a convergent beam of monochromatic light. D. H. F.

See also Abstracts 29, 61, 236, 270.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

162. Theory of Graininess. E. W. H. Selwyn. *Kodak Research Lab., Comm. No.* 557. *Phot. J.* 75. *pp.* 571–580, *Nov.,* 1935.—A photographic deposit of " uniform " density divided into numerous small equal areas is considered. The graininess is considered to be completely described if the statistical distribution of density among these areas is known for all sizes of the areas. It has not been found possible to construct a satisfactory theory of the distribution on a physical basis. Hence an examination is made assuming that the probability that a given area has a density differing from the mean by between Δ and $\Delta + d\,\Delta$ is a function of Δ, $d\,\Delta$, the area a and a " graininess constant " G. If the probabilities of occurrence of given densities in neighbouring areas are independent, and if the density variations are small, the variations from the mean follow a Gaussian law, the " constant of precision " being $G/\sqrt{a}$. It follows that if the apparent brightnesses of photographic deposits are made the same, the magnification at which the apparent graininess has a standard value is inversely proportional to G. If the brightness is not held constant the apparent graininess depends upon the brightness, owing to the variation of contrast sensitivity with brightness. The variation of G with density can only be calculated roughly, but at equal densities G is proportional to the grain diameter. A. H.

***163. Lenses Employed in the Technicolour Process. H. W. Lee.** *Nature,* 136. *pp.* 879–880, *Nov.* 30, 1935.—Prisms introduced between the lens and film produce considerable aberration and necessitate the employment of specially computed lenses. Details are given of the problems encountered in designing large aperture lenses for use in this three colour work, the necessary reduction in the secondary spectrum necessitating the use of a new glass. A. H.

See also Abstract 227.

PHOTOMETRY.

***164. Subjective Photometer. W. D. Wright and J. H. Nelson.** *Journ. Sci. Instruments,* 12. *pp.* 373–377, *Dec.,* 1935.—The object of the photometer is to measure the variation of sensitivity of the eye for different conditions of the visual mechanism and the principle employed is that of binocular matching, in which a patch viewed in the left eye is compared in intensity with a similar patch viewed in the right eye. A calibrated photometer wedge provides the necessary intensity control. Applications of the apparatus include measurements on the effect of adaptation and on the extent of the loss of vision in cases of uniocular blindness. AUTHORS.

***165. Photoelectric Measurement of Blackening. R. Sewig.** *A.T.M.* 5. *pp.* 133–134, *Oct.,* 1935.—Discusses generally the use of photoelectric and photoconductive cells for the measurement of photographic blackening. The basic principles of the measurement of blackening are first discussed, and an enumeration of photoelectric "transformers" given. The electrical measuring systems are then briefly considered, as are the optical systems necessary, the paper concluding with a description of some uses of photoelectric blackening measuring instruments and instruments with a logarithmic characteristic. R. C. F.

166. Photographic Photometry. H. Kienle. *Naturwiss.* 23. *pp.* 759–762, *Nov.* 8, 1935.—Briefly discusses some of the theoretical principles underlying the method of photographic photometry. The measurement of blackening, using diffuse, parallel and converging light rays, is considered, followed by a brief discussion of the measurements of stars, using a scale or by photometric methods. Finally, effects of change of wave-length, variation of time of exposure, and intermittency effects are dealt with. R. C. F.

***167. Neon Lamps in State of Counters. Part II. Potential and Retardation of Discharge ; Processes of Extinction and Revival. G. Valle.** *N. Cimento,* 12. *pp.* 426–440, *July,* 1935.—Investigation is made of the after effect of the impulses of current that traverse an illuminating lamp on the excitation voltage of the same. If between two impulses there occurs in darkness an interval of time of the order of 10^{-2} sec. or less, the retardation of discharge with its effects on the voltage and the counter effect are abolished. The radiations which act on the kathode prolong this time, while they reduce simultaneously the retardation of discharge, if this still presents itself. If the interval of time between two successive impulses is reduced to the order of 10^{-3} sec. the excitation voltage descends below the static value. Over this critical interval of time the radiations have no effect. The probable causes of the phenomena are discussed. [For Part I see Abstract 2070 (1935).] J. J. S.

***168. Photon Counters. R. Audubert.** *J. de Physique et le Radium,* 6. *pp.* 451–456, *Nov.,* 1935.—A general description of photon counters is first given, and the author then gives an account of systematic experiments on their properties. This includes observations on the variation of counting rate with applied voltage, with the value of the associated high resistance and with the intensity of the incident light ; figures for the absolute sensitivity ; and curves of spectral sensitivity. The paper concludes with a brief account of applications of these counters. D. H. F.

***169. Low Intensity Light Measurement with Photon-Counters. Part II. K. H. Kreuchen.** *Zeits. f. Physik,* 97. 9–10. *pp.* 625–632, *Nov.* 12, 1935.—The photoelectric outputs of kathodes of Zn, Cd, and Cu in photon-counters are measured in the region 400 to 185 $m\mu$, using the same technique as previously described [see Abstract 2521 (1935)]. Kathodes consisting of the metals in bulk activated with H_2 were found to give the same yield approximately as kathodes deposited by evaporating the metals. Activation with H_2 did not increase the output of the latter type of kathode. D. H. F.

See also Abstract 186.

POLARISATION.

170. Optical Rotatory Power, Circular Dichroism, Absorption and Refraction in Solutions. W. Kuhn. *Zeits. f. phys. Chem.* 30. *Abt.B.* 5–6. *pp.* 356–378, 1935.—The non-specific influence of the solvent (refractive index n) on the optical properties of solutes is investigated. On transition from gaseous to dissolved states, circular dichroism and rotatory power are each increased by the factor $(n^2 + 2)/3$, whilst the absorption and the contribution of an absorption band to the refractive index (when this is small) increase in the ratio $\{(n^2 + 2)/3\}^2(1/n)$. The relationships between these optical properties remain unchanged provided that all measurements are made under the same conditions. This is illustrated from the available data. The factor for the case of absorption bands must be taken into account in the derivation of their *f*-values from the results of measurements in solution. C. B. A.

171. Rotatory Dispersion of Quartz in Directions Perpendicular to the Optic Axis. G. Bruhat and L. Weil. *Comptes Rendus,* 201. *pp.* 887–889, *Nov.* 12, 1935. *J. de Physique et le Radium,* 7. *pp.* 12–18, *Jan.,* 1936.—The rotatory dispersion of quartz in directions perpendicular to the optic axis is measured at wave-lengths between 2537 and 5780 Å. The ratio of the rotation perpendicular to the axis to that parallel to the axis is constant to 0·5 %, the mean value being − 0·54 over the whole range, so that the dispersion is the same for both directions. C. B. A.

172. Analysis of Elliptical Vibrations by Plain Mica-Plate Compensator. G. Bruhat and P. Grivet. *Rev. d'Optique,* 14. *pp.* 217–247, *June–July, and pp.* 354–371, *Oct.,* 1935.—The analysis of monochromatic elliptical vibrations with a compensator consisting of a plain crystal plate can be carried out accurately if account is taken of the rays which have undergone multiple reflection inside the compensator. Under suitable conditions, the relative error can then be reduced to the order of 1 in 1000. As a result of the multiple reflections, the constants of the compensator vary very rapidly with wave-length, a displacement of 1 Å in the centre of gravity of the radiation employed producing a variation of 2 % in the retardation; but experiment shows that for the lines of the Hg arc, the centre of gravity can be defined with sufficient accuracy to give reproducibility to 1 part in 400. The orientation of the major axis of an elliptical vibration with ellipticity β up to 30° can be determined to 1 or 2′ by the photoelectric method, which, with the help of a $\lambda/4$ mica-plate, can be used to analyse any elliptical vibration of λ greater than 3000 Å. Methods applicable for $\beta < 30°$ or between 30° and 45° respectively are described. The relative error in the ratio of the two axes so determined is not greater than 1 part in 400. C. B. A.

See also Abstracts 29, 202, 230, 236.

RADIATION, EMISSION.

173. Problems of the Ionosphere. G. J. Elias. *E.N.T.* 12. *pp.* 318–325, *Oct.*, 1935.—A résumé is given of the author's investigations of the properties of the ionosphere and the results are discussed in their bearing on various problems and ionosphere theories. A. W.

174. Eclipse Effects in the Ionosphere. J. P. Schafer and W. M. Goodall. *I.R.E., Proc.* 23. *pp.* 1356–1360, *Nov.*, 1935.—It is concluded from measurements of virtual heights and critical ionisation frequencies of the various regions of the ionosphere made during two solar eclipses at Deal, New Jersey, that u.v. light is an important ionising agency in the E-, M-, F_1- and F_2- regions. AUTHORS.

***175. Simultaneous Measurement of Ionisation Collisions and of Intensity of Cosmic Radiation. A. Gastell.** *Zeits. f. Physik,* 97. 7–8. *pp.* 403–413, *Oct.* 25, 1935.—A description is given of an automatic apparatus with a large ionisation chamber, 500 l. in volume, for the accurate and rapid measurement of collisions and at the same time of the intensity of cosmic radiation. The compensation of the ionisation current is attained by means of two rotatory condensers which set at an angle of 180° produce by influence in the system on their rotation an accurately adjustable constant current. The movements of the electrometer are permanently registered by photography. J. J. S.

176. Ionisation Collisions of Cosmic Radiation. A. Gastell. *Zeits. f. Physik,* 97. 7–8. *pp.* 414–435, *Oct.* 25, 1935.—A pressure curve for collisions is obtained and it is shown that the gas in the ionisation chamber [see preceding Abstract] plays only a subordinate part. By variation in the shielding a change of the distribution curve is produced. The secondary radiation of the cosmic radiation which gives rise to collisions is investigated. A strong barometer effect, amounting to 5 % per mm. Hg for the smallest collisions, is found, and also a dependence of the frequency of collisions on the time of day. J. J. S.

177. Showers of Rays which Produce Bursts of Cosmic-Ray Ionisation. C. G. and D. D. Montgomery. *Phys. Rev.* 48. *pp.* 786–789, *Nov.* 15, 1935.—An expression for the probability that a shower of a given number of rays will discharge a number of Geiger-Müller counters is derived and experimentally verified by observing the bursts of ionisation in an ionisation chamber and the simultaneously occurring discharges of three counters placed under the chamber. An estimate is made of the relative importance of the contributions of showers of various numbers of rays to the counting rate of counters placed out of line. The view that there is no sharp distinction between small showers as observed in cloud chambers and the very large showers which produce the bursts of ionisation, or *Stösse,* in ionisation chambers is emphasised. The results have a significant bearing upon the interpretation of counter experiments on showers. AUTHORS.

178. Penetrating Radiation. P. M. S. Blackett. *Zeits. f. techn. Physik,* 16. 11. *pp.* 379–382, 1935. *Phys. Zeits.* 36. *pp.* 773–776, *Dec.* 1, 1935.—Review of problems connected with penetrating radiation with special reference to shower formation. F. C. C.

179. Passage of Penetrating Radiation through Matter. H. Kulenkampff. *Zeits. f. techn. Physik,* 16. 11. *pp.* 391–393, 1935. *Phys. Zeits.* 36. *pp.* 785–787, *Dec.* 1, 1935.—Coincidence experiments with 3 and 4 counters arranged vertically are carried out with absorbing sheets placed between and above the counters. The production of a secondary corpuscular radiation with a range of about 35 cm. of Fe is established, and the absorption coefficient of the γ-type radiation which the corpuscular radiation produced in the absorber was found to be $0 \cdot 009$ cm^{-1}. Fe. F. C. C.

180. Ionisation of Penetrating Radiation with a Double Ionisation Chamber. W. Messerschmidt. *Zeits. f. techn. Physik*, 16. 11. *pp.* 394–395, 1935. *Phys. Zeits.* 36. *pp.* 788–791, *Dec.* 1, 1935.—A half-value thickness of 3·5 cm. of Pb is found for the absorption of Hoffmann collisions, using a double ionisation chamber. The collisions, which consist of showers of many particles, are considered to have a complicated origin compared with that of the showers containing a few particles. F. C. C.

181. Solar Component of Penetrating Radiation. J. Barnóthy and M. Forró. *Zeits. f. techn. Physik*, 16. 11. *pp.* 395–397, 1935. *Phys. Zeits.* 36. *pp.* 789–791, *Dec.* 1, 1935.—Using a double counter coincidence arrangement, 4 series of measurements gave an average of 1·88 ± 3·44% greater intensity when in the direction of the sun than on the average in other directions. The experimental error did not therefore permit a test of the existence of a solar component. The intensity of the radiation from the sun is certainly not more than 13 times that of a quadrant of the whole celestial vault. F. C. C.

182. Penetrating Radiation and Nova Herculis. V. F. Hess and R. Steinmaurer, C. O'Brolchain, B. F. J. Schonland and B. Delatizky, H. Nie and E. G. Steinke. *Zeits. f. techn. Physik*, 16. 11. *pp.* 397–400, 1935. *Phys. Zeits.* 36. *pp.* 791–795, *Dec.* 1, 1935.—Simultaneous readings were made with a Steinke apparatus at different places and altitudes during the outbursts of Nova Herculis. The results gave no grounds for connecting the outbursts with increased intensity of penetrating radiation. F. C. C.

183. Measurement of Penetrating Radiation in the Stratosphere with a Triple Coincidence Apparatus. G. Pfotzer. *Zeits. f. techn. Physik*, 16. 11. *pp.* 400–401, 1935. *Phys. Zeits.* 36. *pp.* 794–795, *Dec.* 1, 1935.—With an automatically registering triple coincidence counting apparatus the intensity of penetrating radiation in a vertical direction was determined down to a pressure of 37·5 mm. of Hg corresponding to a height of 22 km. Maximum intensity was observed at 100 mm. and a slight hump in the curve occurred at 300 mm. F. C. C.

184. Method of Registration of Hoffmann Collisions. F. Weischedel. *Zeits. f. techn. Physik*, 16. 11. *pp.* 402–404, 1935. *Phys. Zeits.* 36. *pp.* 796–798, *Dec.* 1, 1935.—It is shown that an ionisation chamber may be made self-registering for Hoffmann collisions by continuous illumination of the string of the electrometer. Results were obtained below an absorbing layer of 130 m. of water. F. C. C.

185. Directional Effect of Penetrating Radiation. A. Ehmert. *Zeits. f. techn. Physik*, 16. 11. *pp.* 404–407, 1935. *Phys. Zeits.* 36. *pp.* 798–801, *Dec.* 1, 1935.—Using two simultaneously registering coincidence counting arrangements, the directional effect of penetrating radiation is examined. To make statistical fluctuations as low as possible is was found essential to take a very large number of measurements. F. C. C.

See also Abstract 238.

REFLECTION. REFRACTION AND DISPERSION.

***186. Priest-Lange Reflectometer. I. G. Priest.** *Bureau of Standards, J. of Research*, 15. *pp.* 529–552, *Nov.*, 1935.—The Priest-Lange

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reflectometer is described in detail and the theory of its use given for determining relative reflectance for various spectral distributions of illumination. A method for measuring spectral selectivity of reflectance is also described, together with a method for measuring diffuse-plus-specular reflectance as distinguished from diffuse reflectance alone for perfectly polished specimens. The application of the instrument to porcelain enamel samples is illustrated by a detailed account of measurements made on seven typical samples. The method for measuring diffuse-plus-specular reflectance as distinguished from diffuse reflectance is shown to be inapplicable to enamel samples because of their optical imperfections, but measurements of spectral selectivity are shown to give results in close correlation with the colours of the samples observed directly. AUTHOR.

187. Phase Contrast Procedure with Microscopic Observation. F. Zernike. *Zeits. f. techn. Physik*, 16. 11. *pp.* 454–457, 1935. *Phys. Zeits.* 36. *pp.* 848–851, *Dec.* 1, 1935.—In the theory of microscope images for non-absorbing objects different methods were adopted in the calculations by Rayleigh and Abbé and these are discussed first. It is shown that the different perception of these objects according to the kind of illumination can be explained with successive application of the Abbé theory as due to the influence of the refracted image of the light source. At the same time the better method of phase contrast results by which the direct image of the source of light is altered only in phase. R. S. R.

188. Optical Calibration Problem. T. Smith. *Phys. Soc., Proc.* 48. *pp.* 75–78, *Jan.* 1, 1936.—Suitable measures are obtained for the uncertainty, corresponding to a fixed error of phase, in the object-image relationship of a symmetrical optical instrument. For a thin lens with its aperture stop in contact with the lens the uncertainty is proportional to the distance between the object and the image. The formulæ are utilised to determine the most accurate values of the coefficients in the object-image relationship from observations including many pairs of coordinates. The results given by the phase criterion, unlike those derived by a purely geometrical treatment, are unaltered if the object and image spaces are interchanged. AUTHOR.

189. Molecular Refractivity of Ethyl Alcohol-Benzene Mixtures. P. Trautteur. *N. Cimento*, 12. *pp.* 444–447, *July*, 1935.—Refractive indices and densities of C_2H_5OH-C_6H_6 mixtures have been measured and the molecular refractivities calculated. The refractive index increases linearly with the benzene concentration, the contribution of the alcohol to the molecular refractivity remaining constant within the limits of experimental error. The results show that the refractivity is much less sensitive to the effects of association than either the dielectric constant or infra-red absorption [see Abstract 208 (1936)]. C. J. B. C.

190. Infra-Red Dispersion of Hydrogen Chloride. R. and A. H. Rollefson. *Phys. Rev.* 48. *pp.* 779–785, *Nov.* 15, 1935.—The optical dispersion of HCl has been measured between 1 and 10μ in order to investigate the discrepancy between the temperature invariant part of the dielectric constant and the square of the refractive index extrapolated to infinite wave-length. The effective charge of the molecule has been determined and indicates that the discrepancy mentioned cannot arise from the refraction term. The contribution of rotation to the refraction term has been estimated and gives a quantitative check on the negative terms in the Kramers dispersion formula. From this the electric moment can be determined and a value in agreement with that from dielectric constant measurements is found. W. R. A.

191. Infra-Red Dispersion of Carbon Disulphide and Carbon Tetrachloride. A. H. Pfund. *J.O.S.A.* 25. *pp.* 351–354, *Nov.*, 1935.—Hollow prisms with sides of polished rock-salt were used and data obtained to 11·06 μ for CS_2 and to 9·21 μ for CCl_4. W. R. A.

192. Refractive Liquids in Optical Combinations. J. Duclaux and P. Jeantet. *Rev. d'Optique*, 14. *pp.* 345–353, *Oct.*, 1935.—The refractive indices, dispersions and transparencies of a number of concentrated aqueous solutions and organic liquids are studied with a view to their use instead of glass in optical systems. Compared with glass, the variation in properties obtainable is considerably larger; and it is concluded that in combination with one another or with glass such substances might produce better prism systems than are possible with glass alone. C. B. A.

193. Improved Vision with the Telescope. J. Flügge. *Zeits. f. Instrumentenk.* 55. *pp.* 465–467, *Nov.*, 1935.—Reference is made to an error in sign in the expression for the sharpness of vision given earlier [see Abstract 4241 (1935)]. Kühl does not accept the expression for twilight vision since for darkness [E = 0] S is still finite. The author shows that the expression fits the observations over the range considered and the magnification passes through a minimum and approaches asymptotically the magnification for a telescope with very large and very small intensities of illumination. R. S. R.

See also Abstracts 47, 88, 163, 170, 198, 302.

SPECTROSCOPY.

194. Absorption Spectrum of Lead Vapour in the Schumann Region. N. V. Kremenevskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 6. *pp.* 251–252, 1935. *In English.*—The absorption spectrum of lead vapour is examined from λ2200 to λ1350 at temperatures varying from 420° C. to 1070° C. Both line and band absorption are observed and a number of the observed lines are allocated to various PbI series. A. H.

195. Influence of Foreign Gases on the High Principal Series Lines of Sodium. C. Füchtbauer and P. Schulz. *Zeits. f. Physik*, 97. 11–12. *pp.* 699–707, *Nov.* 25, 1935.—The broadening of the lines of the end of the Na series by He, Ne, A, H and N is measured. With all gases the breadth decreases with the series term number and attains finally a constant limiting value. The end value appears to be independent of the absorbing alkali, and depends only on the foreign gas. For the inert gases, after He, the end breadths as the broadenings increase with the atomic number. The existing asymmetries occur at the series end towards the red. J. J. S.

196. Influence of Heavy Water of Crystallisation on the Line Absorption Spectra of Chrome Alums. G. Joos and H. Böhm. *Zeits. f. techn. Physik*, 16. 11. *pp.* 432–433, 1935. *Phys. Zeits.* 36. *pp.* 826–827, *Dec.* 1, 1935.—The water of crystallisation of potassium chromium selenate alum is replaced by heavy water D_2O and it is found that this promotes considerable displacements of absorption lines thus proving that the lattice or complex vibrations are involved in the production of these lines. J. E. K.

197. Fine Structure in the Limit Terms of the (^{2}D) Series of the I$^+$ Spectrum. S. Tolansky. *Phys. Soc., Proc.* 48. *pp.* 49–56, *Jan.* 1, 1936.—The 11 lines of the I$^+$ spectrum which were previously analysed for fine structure belong to the (^{4}S) system. The analysis is now extended to the (^{2}D) system, 14 lines having been analysed and fine-structure interval factors found for 12 terms. This brings the known number of interval factors up to 23. Large interval factors are found associated with the *5d* electron terms of both the systems. This is correlated with observations in the Sn II fine structures, and it is shown that the large *5d* interval factors are due to perturbation by terms with large fine structure. Two types of perturbation in the fine structures are observed. AUTHOR.

198. Anomalous Dispersion of the First Doublets of Sr$^+$ and Ba$^+$. L. Allegretti. *Accad. Lincei, Atti*, 22. *pp.* 256–258, *Sept.*, 1935.—Determinations of the relative intensity of the components of the first doublet of the principal series of Ba$^+$ and Sr$^+$ are made using Puccianti's method for the measurement of anomalous dispersion. The following values of the ratio of the coefficients of anomalous dispersion for the two components were obtained: Sr$^+$, 2·07; Ba$^+$, 2·16. Puccianti's measurements gave the value 2·02 for Ca$^+$, and the Burger-Dorgelo rule indicates that the intensity ratio should equal 2. W. S. S.

199. Intensification of Hg Lines in a Hg-H$_2$ Discharge on Drying. H. Beck. *Zeits. f. Physik*, 97. 5–6. *pp.* 382–389, *Oct.* 18, 1935.—The introduction of P_2O_5 into the discharge tube is found to increase the intensity of the mercury lines in a Hg-H$_2$ discharge, confirming the observations of Güntherschulze and his collaborators. Control experiments established that the effect was due in fact to drying of the gas and not to the removal of impurities. Attempts to obtain the effect under controlled conditions by excitation with a homogeneous electron beam in a field-free space were unsuccessful. Schitger's assumption that metastable Hg atoms play a part in the effect is shown to be untenable from measurements of the absorption in the discharge which indicate instead that the protons are responsible for the observed intensification. W. S. S.

200. Computation of Spectral Intensities for Hydrogen. P. Rudnick. *Phys. Rev.* 48. *pp.* 807–811, *Nov.* 15, 1935.—A new form, designed to facilitate computation, is given for the radial integral involved in the theoretical intensities for the atomic H spectrum. A comparison is made between several published sets of numerical computations, and some corrections are made, both algebraic and arithmetical. The purpose throughout is to give information useful to anyone using or extending the published computations. AUTHOR.

201. Absolute Intensities in Spectrum of Low-Pressure Quartz-Mercury Arcs. A. J. Maddock. *Phys. Soc., Proc.* 48. *pp.* 57–62, *Jan.* 1, 1936.—Absolute intensities of the main wave-lengths between 6000 and 2400 Å emitted by a commercial type of a very low-pressure mercury-vapour discharge burner are tabulated, and some theoretical aspects of the results as compared with those for high-pressure arcs are considered. Therapeutic effects of the two types of burner are discussed with reference to the production of erythema. AUTHOR.

202. Coherence of Vibrations in Optical Resonance. P. Soleillet. *Comptes Rendus*, 201. *pp.* 945–946, *Nov.* 18, 1935.—It is known that the polarisation of optical resonance emission can be calculated from transition probabilities when the vibrations corresponding to the magnetic components of a hyperfine structure line can be considered as incoherent;

i.e., when the magnetic splitting exceeds the natural line-width, and also under particular conditions of excitation with zero field. The author has shown also [see Abstract 590 (1930)] that the polarisation can be calculated for any conditions whatever in zero field ; the results can only be interpreted on the assumption of a certain coherence between the various vibrations in a vanishing field of arbitrary direction. There is a close connection between this coherence and that of the three excitation vibration components with the same axis as the field ; this connection leads to a quantitative prediction of results. The theory has been generalised for the case of an emission due to step excitation. Rather complicated formulæ are established which give the polarisation of the emitted radiation as a function of those of the excitation radiations. W. J.

203. Flame Spectra of Aromatic Compounds. W. M. Vaidya. *Indian Acad. Sci., Proc. 2A. pp.* 352–357, *Oct.*, 1935.—Bands attributed to HCO are found to occur in the spectra of the flames of benzene and other aromatic compounds. The spectra of aliphatic and aromatic flames are compared and it is found that there is a gradual variation in the spectra of the aliphatic flames whilst there is more uniformity in the spectra of benzene and its related compounds. Based on the spectroscopic evidence a tentative scheme is given for the combustion of benzene. A. H.

204. Emission Spectrum of SeO. L. and E. Bloch and Choong Shin-Piaw. *Comptes Rendus*, 201. *pp.* 824–825, *Nov.* 4, 1935.—Following up the examination of the absorption spectrum of SeH [see Abstract 5029 (1935)] an attempt is made to detect the emission spectrum of this molecule, h.f. excitation being employed. Bands degrading to the red, are obtained from λ3800 to λ2880, most of the heads being double. The spectrum closely resembles that due to SO and it is concluded that it is due to SeO. The heads may be represented by :

$$\nu = 33{,}873\cdot5 + [533\cdot4(v'+\tfrac{1}{2}) - 8\cdot7(v'+\tfrac{1}{2})^2] - [908\cdot9(v''+\tfrac{1}{2}) - 4\cdot8(v''+\tfrac{1}{2})^2].$$

A. H.

205. SiBr Bands. E. Miescher. *Helv. Phys. Acta*, 8. 7. *pp.* 587–588, 1935. *In German.*—In the spectrum of the electrodeless discharge through $SiBr_4$ vapour the region λλ3240–3870 is occupied by a strong system of SiBr emission bands degraded towards the further u.v. The system is photographed in a three-prism quartz spectrograph (dispersion 15 Å./mm. at λ3000). The wave-numbers of 24 heads, apparently single, are measured and represented by :

$$\nu = 33{,}570 + [578\cdot3(v'+\tfrac{1}{2}) - 4\cdot3(v'+\tfrac{1}{2})^2] - [424\cdot6(v''+\tfrac{1}{2}) - 1\cdot3(v''+\tfrac{1}{2})^2],$$

where $v' = 0$ to 2 and $v'' = 0$ to 9. Apart from the break-off at $v' = 2$, which is probably due to predissociation of the upper state, the intensity distribution is of the usual Condon type. The unresolved isotope effect of Br causes slight diffuseness of outlying band-heads ; that of Si is not detected. W. J.

206. Search for Isotope Effect in Gold Hydride Band Spectrum. S. Imanishi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 607. *pp.* 129–134, *Nov.*, 1935. *In English.*—From the accepted atomic weight of gold 197·21 an abundance ratio 1 : 8·3 or 1 : 7·0 is obtained for $Au^{199} : Au^{197}$. Each rotational line of several vibrational bands belonging to the AuH $^1\Sigma \rightarrow {}^1\Sigma$ system in the violet region is examined with an interference spectrograph comprising a reflecting echelon, a Lummer plate or a transmission echelon. Contrary to expectation, and in agreement with A. J. Dempster's mass-spectrographic results (*Nature*, 136.

p. 65, *July* 13, 1935), no Au^{199}H lines are found and the singleness of the constitution of gold is confirmed. AUTHOR.

207. New Afterglow Spectrum in Nitrogen. J. Kaplan. *Phys. Rev.* 48. *pp*. 800–801, *Nov*. 15, 1935.—A new nitrogen afterglow spectrum is described in which the Vegard-Kaplan bands, which are emitted by the $A^3\Sigma$ metastable molecule, are the most intense components. This afterglow is associated with very weak discharges in tubes which are in a condition to give the auroral afterglow at higher currents. Attention is called to the fact that each of the three distinct nitrogen afterglow spectra is associated with a characteristic discharge spectrum. AUTHOR.

208. Effect of Molecular Association on Infra-Red Absorption. A. Malone. *N. Cimento*, 12. *pp*. 441–443, *July*, 1935.—The infra-red absorption band of C_2H_5OH at 3μ, characteristic of the OH group, has been measured for mixtures of C_2H_5OH and C_6H_6 in varying proportions by a method previously described [see Abstract 3042 (1935)]. This band was chosen as it is particularly sensitive to the effects of molecular association [see Abstract 5016 (1935)]. The intensity of the band is always greater for mixtures than for the pure alcohol. This is ascribed to association of the C_2H_5OH molecule, which decreases on the introduction of the benzene. The intensity increases to a maximum at about 70 % benzene, after which it decreases. [See also Abstract 189 (1936).]

C. J. B. C.

209. Infra-Red Absorption Spectra of 1-2 Dihalogen Derivatives of Ethane. Hua-Chih Cheng and J. Lecomte. *J. de Physique et le Radium*, 6. *pp*. 477–485, *Nov*., 1935.—The absorption spectra of $C_2H_4Br_2$, C_2H_4ClBr, $C_2H_4Cl_2$, C_2H_4ClI, and $C_2H_4I_2$ were photographed in the wave-length range of 6–19·5 μ, and between the visible and 1·1 μ. Positions and intensities of absorption bands and Raman lines, and wave-length-transmission curves are given. The modes of vibration of the molecule corresponding to the measured bands are investigated. Assuming the existence, for the derivatives, of steroisomeric cis- and trans-forms, all the main absorption maxima and most of the secondary maxima are classified. N. M. B.

210. Infra-Red Absorption Spectrum of Germane. W. B. Steward and H. H. Nielsen. *Phys. Rev.* 48. *pp*. 861–864, *Dec*. 1, 1935.—The infra-red spectrum of GeH_4 is measured to determine the fundamental vibration frequencies and to investigate the rotational structure of the bands. Intense absorption regions are found, enumerated in the order of their intensities, at $4{\cdot}74\mu$ (2110 cm.$^{-1}$), $10{\cdot}7\mu$ (934 cm.$^{-1}$), $3{\cdot}4\mu$ (2922·7 cm.$^{-1}$ and 3031 cm.$^{-1}$) and $2{\cdot}3\mu$ (4300 cm.$^{-1}$) which are respectively identified as ν_3, ν_4, $\nu_1 + \nu_4$, $\nu_3 + \nu_4$, and $2\nu_3$. A much weaker absorption peak near $5{\cdot}7\mu$ is identified as $\nu_2 + \nu_4$. From the spacings between the principal rotation lines in the fundamentals ν_3 and ν_4 a value $7{\cdot}0 \times 10^{-40}$ gm.-cm^2. for the moment of inertia of the molecule and values $1{\cdot}37 \times 10^{-8}$ and $2{\cdot}06 \times 10^{-8}$ cm., respectively, for the Ge-H and the H-H distances are indicated. AUTHORS.

211. Infra-Red Absorption Bands of Methane. A. H. Nielsen and H. H. Nielsen. *Phys. Rev.* 48. *pp*. 864–867, *Dec*. 1, 1935.—The two fundamental vibration-rotation bands ν_3 and ν_4 of methane are remeasured with greater resolution than that available in the earlier investigation of Cooley. Whereas the band at $3{\cdot}3\mu$ shows no essentially new details, the fundamental band at $7{\cdot}7\mu$ is found to possess a somewhat more complex rotational structure than was observed by Cooley. Many of the lines given in Cooley's curve are here resolved into groups of closely spaced components. The separation between the components within a group appears to increase with the ordinal number of the line counted outward from the centre of the band. In addition to these measurements, the two combination bands $\nu_1 + \nu_4$ at 4218 cm.$^{-1}$ and $\nu_3 + \nu_4$ at 4315 cm.$^{-1}$ are at least partially resolved and appear to have line spacings of about 5·3 cm.$^{-1}$ and 13·5 cm.$^{-1}$, respectively. AUTHORS.

212. Absorption Spectrum of Liquid Oxygen. P. Tulipano. *N. Cimento,* 12. *pp.* 418–422, *July,* 1935.—An investigation was made of the absorption bands in the visible spectrum of liquid oxygen, using a Rowland's grating with high dispersion. On the basis of the results of J. W. Ellis and H. O. Kneser [see Abstract 660 (1934)] it is possible to make a classification of these bands, attributing the cause of this absorption to the presence of O_4 molecules. Seven absorption bands were photographed and the absorption curves of these are given. It results from the figures that each of the three types of bands corresponding to a definite quantic electronic jump has a corresponding type of absorption curve. [See following Abstract.] J. J. S.

213. Absorption Spectrum of Liquid Oxygen. A. Carrelli. *N. Cimento,* 12. *pp.* 423–425, *July,* 1935.—A theoretical discussion is given of the interpretation of the results recently obtained in observations on the absorption of oxygen [See Abstract 660 (1934) and preceding Abstract.] These interpretations are based on the theory that in liquid O (and from recent results probably also in solid O) there exist molecules $O_2 - O_2$, owing to forces of polarisation; the absorption spectrum presented by these molecules of polarisation being constituted by the superposition of the absorption spectra due to the two molecules of O that form the molecule $(O_2)_2$. Difficulties in the interpretation are considered. J. J. S.

214. Absorption Spectra of Nitrophenylhydrazines. A. K. Macbeth and J. R. Price. *Chem. Soc., J. pp.* 1563–1567, *Nov.,* 1935.—The u.v. absorption spectra of a number of nitrophenylhydrazines are recorded and their origin is discussed with reference to the molecular structures of the compounds. C. B. A.

215. Absorption Spectra and Constitution of Isatin and Carbostyril Derivatives. R. G. Ault, E. L. Hirst and R. A. Morton. *Chem. Soc., J. pp.* 1653–1657, *Nov.,* 1935.—The absorption spectra of isatin and of its N- and O-methyl derivatives are measured under conditions which preclude errors due to decomposition of the materials. In contradiction of the results of Hartley and Dobbie and of Dabrowski and Marchlewski, but in confirmation of the work of Hantzch and of Morton and Rogers, it is found that the three spectra are similar but not identical. No certainty can therefore be attached to conclusions as to the molecular structure of isatin on this evidence alone. A number of derivatives of isatin are described and their absorption spectra are recorded. They fall into two groups, and these results are discussed in relation to molecular structure. C. B. A.

216. Absorption Spectrum of I_2 in the Vacuum Ultra-Violet. H. Cordes. *Zeits. f. Physik,* 97. 9–10. *pp.* 603–624, *Nov.* 12, 1935.—The absorption spectrum of the I_2 molecule is recorded from 1950 to 1500Å with a high-dispersion fluorspar vacuum spectrograph. The absorption bands are arranged into eight series, which are described, together with continuous absorption which sets in at 1505 Å. The absorption systems correspond to transitions from the $^1\Sigma_g^+$ ground state into various excited states, of which two are components of a $^3\Pi_u$ multiplett, and two others are $(^2\Pi_{\frac{1}{2}}\sigma)\ \Pi\sigma,_{1u}$ and $(^2\Pi_{3/2}\sigma)\ \Pi_{1,2u}$, whose components $\Omega = 0^+, 1$, $\Omega = 1, 2$ are not resolved. In the limit, the excited molecule dissociates into a 6 *s* ^4P and a 5 *p* ^2P iodine atom. Extrapolation of the convergence limit of another system leads to the value 7·33 ± 0·10 V. The upper state of the system is interpreted as $^1\Sigma_u^+$. At the limit, dissociation into $^1S_0J^- + {}^3P_2J^+$ occurs. Ionisation of the iodine atom requires 8·9 ± 0·2 V. Other excited states are investigated and the u.v. fluorescence spectrum is discussed on the basis of the absorption results. C. B. A.

217. Ultra-Violet Absorption Spectra and Ionisation of Very Weak Bases. L. A. Flexser, L. P. Hammett and A. Dingwall. *Am. Chem. Soc., J.* 57. *pp.* 2103–2115, *Nov.*, 1935.—The ultra-violet absorption spectra in various solvents are determined of benzoic acid, 2,4-dinitrophenol, aniline, acetophenone, anthraquinone, phenylacetic acid and *p*-nitrobenzoic acid. The validity of u.v. spectrophotometry as a method of measuring ionisation is demonstrated for a carboxylic acid and a phenol, and for an oxygen and a nitrogen base. Mathematical methods are devised for taking into account the effect of changing solvent in measuring the strength of very weak bases. Criteria are established for the choice of indicators to be used in changing media. The strengths of the following very weak bases are measured: acetophenone, benzoic acid and phenylacetic acid. AUTHORS.

218. Optical Behaviour of Dissolved Ions and the Structure of Electrolytic Solutions. Part I. Temperature Variation and Salt Effect in the Absorption Spectrum of 2,4-Dinitrophenolate. G. Kortüm. *Zeits. f. phys. Chem.* 30. *Abt.B.* 5–6. *pp.* 317–355, 1935.—The limits of "optical constancy" for a dissolved ion are investigated by means of photoelectric precision measurements of the long wave-length absorption band of aqueous solutions of 2,4-dinitrophenolate ions in the presence of various salts. Over a range of concentrations in which all other ionic properties susceptible to electrostatic influences are affected to the extent of many per cent, the extinction coefficients remain constant to 0·02 %. At higher concentrations, a displacement of the band is observed depending on the particular salt added. It is shown that the explanation of this displacement as being due to a Stark effect is in no way justifiable. The formation of associated ion-pairs is unlikely, since the optical effect of the added ions is not proportional to their concentration, and kations and anions produce effects of similar magnitude. A relationship exists between the specific influence of various salts and their hydration energy, suggesting that interactions with solvent molecules are responsible for the optical behaviour of strong electrolytes. Numerically, electrostatic dipole forces in dilute aqueous solutions are of a different order of magnitude from the Coulomb forces between oppositely charged ions. These results are confirmed by measurements of the effect of non-electrolytes and of temperature on the absorption spectrum, and also by the data available from other optical measurements on aqueous electrolytic solutions. C. B. A.

219. Ultra-Violet Absorption and Raman Spectra of Pyridine. V. Henri and P. Angenot. *Comptes Rendus*, 201. *pp.* 895–896, *Nov.* 12, 1935.—Observations are made of the u.v. absorption spectrum of pyridine vapour, at various temperatures and pressures. Five molecular vibration fundamentals are found for the unexcited molecule at 600, 857, 993, 1031 and 1159 cm^{-1}. These are compared with the Raman spectrum vibrations at 606, 884, 990, 1029, 1155 cm^{-1}. Five series of bands are recognised and their formulæ given. [See Abstract 2118 (1935).] A. C. M.

220. Perturbations in the Second Positive Bands of Nitrogen. D. Coster and F. Brons. *Zeits. f. Physik*, 97. 9–10. *pp.* 570–572 *Nov.* 12, 1935.—Perturbations are examined in the spectrum of the second positive bands of nitrogen, where the states $v = 2$ and 3 of the level $^3\Pi C$ are concerned. Gerö's analysis has been applied [see Abstract **2121** (1935)] without bringing anything new to light. The perturbations are of a curious character; lines are greatly weakened, but not shifted, while preceding and following lines are not in the least affected. A. C. M.

221. Rotational Structure of the Schumann-Runge Bands of Oxygen in the Vacuum Region. H. P. Knauss and S. S. Ballard. *Phys. Rev.* 48. *pp.* 796–799, *Nov.* 15, 1935.—Absorption bands of the Schumann-Runge system of oxygen are photographed with a 3-m. vacuum spectrograph in the region λ1760–λ1925. A rotational analysis yields constants for the upper states which are new in the range $v' = 8$ to 15 inclusive. Origins of the bands in this progression are represented within the limits of accuracy of the observations by the following equation—

$$\nu_{(v',\,0)} = 49014 \cdot 93 + 700 \cdot 360(v+\tfrac{1}{2}) - 8 \cdot 0023(v+\tfrac{1}{2})^2 - 0 \cdot 37535(v+\tfrac{1}{2})^3.$$

The energy of dissociation, D_0'', is 5·05 volts. AUTHORS.

222. Fundamental Frequencies of the Cyanogen Molecule. Sho-Chow Woo, Ta-Kong Liu, and T. C. Chu. *Chinese Chem. Soc., J.* 3. *pp.* 301–307, *Nov.*, 1935. *In English.*—The restoring force constants of the linkings in the molecules HCN, ClCN, BrCN, C_2N_2, and C_2H_2 are calculated from the fundamental frequencies of the valency vibrations. From the results, with the selection rule for infra-red and Raman spectra and the heats of formation of the respective linkings, revised assignments of the fundamental frequencies of the C_2N_2 molecule are given. N. M. B.

223. Splitting of Vibration-Rotation Levels in Polyatomic Molecules. E. B. Wilson, Jr. *J. Chem. Phys.* 3. *pp.* 818–821, *Dec.*, 1935.—The interaction of rotation and vibration and perhaps other effects may split degenerate vibration-rotation energy levels of symmetrical polyatomic molecules into a number of components. The permutation symmetry of molecules containing several identical atoms provides certain restrictions on this splitting. This paper discusses the maximum number of fine-structure components, their quantum weights when nuclear spins are taken into account, and the selection rule for transitions. All arguments are based solely on symmetry considerations so that no estimate of the magnitude of the splitting is given. AUTHOR.

224. Interaction between Vibration and Rotation for Symmetrical Molecules. M. Johnston and D. M. Dennison. *Phys. Rev.* 48. *pp.* 868–883, *Dec.* 1, 1935.—For interpreting the spectra of polyatomic molecules a simple model is known. However, a serious difficulty has appeared in that the simple model predicts that for a given molecule all the infra-red bands which correspond to a particular type of vibration should show the same fine structure. This is not always the case and Teller has recently indicated a solution. This theory has been rigorously extended and detailed calculations are made for several models. In the case of CH_3Cl and NH_3 molecules satisfactory agreement is obtained but in the case of silane the agreement is not so satisfactory. A. H.

225. Continuous Spectrum of Deuterium. Arlette Tournaire and E. Vassy. *Comptes Rendus,* 201. *pp.* 957–958, *Nov.* 18, 1935.—A microphotometric study is made of the continuous spectrum due to D_2, and a comparison is made with that due to H_2 [see Abstract 2051 (1934)]. The spectrum examined stretches from λ4861 to λ2300 and, arranging that the microphotometric curves coincide at λ4000, it is found that below this wave-length the continuum due to D_2 is slightly more intense than that due to H_2. A. H.

226. Ultra-Violet Absorption of Mixtures of NO, NO_2 and H_2O. E. H. Melvin and O. R. Wulf. *J. Chem. Phys.* 3. *pp.* 755–759, *Dec.,* 1935.—In considerable amounts of NO containing small amounts of NO_2 a continuous absorption occurs in the ultra-violet, obscuring both the absorption of NO and that portion of the absorption of NO_2 which lies below 2500 Å. The behaviour of this absorption with respect to temperature and the partial pressures of the constituents is rather convincing evidence that it is due to N_2O_3. When very small amounts of water are also present a group of bands occurs in the near ultra-violet, lying in the same region but not resembling the longer wave-length NO_2 absorption. These bands appear diffuse under low dispersion but possess an ordered arrangement. With increase of temperature the intensity of the bands decreases rapidly. They begin in the vicinity of 3850 Å, extending to shorter wave-lengths. The first members are broader and more diffuse than those that follow, indicating a predissociation process in the carrier, which is probably HONO. AUTHORS.

227. Absorption Spectra of the Chlorides and Oxychlorides of Sulphur. R. K. Asundi and R. Samuel. *Phys. Soc., Proc.* 48. *pp.* 28–34, *Jan.* 1, 1936.—The absorption spectra of the vapours of SCl_2, S_2Cl_2, $SOCl_2$ and SO_2Cl_2 have been investigated in the visible and ultra-violet regions, and the continuous absorptions observed are correlated with photo-dissociation processes. AUTHORS.

228. Lines of Helium and Hydrogen with Crossed Electric and Magnetic Fields. W. Steubing. *Zeits. f. techn. Physik,* 16. 11. *pp.* 428–431, 1935. *Phys. Zeits.* 36. *pp.* 822–825, *Dec.* 1, 1935.—The changes undergone by the magnetically split doublets of the Stark effect components of the first subsidiary series of He when the strength of the electric field is varied are illustrated by two examples. Preliminary results of investigations of hydrogen indicate that the diffuse Stark effect components of H_β and H_γ show the same enlarged separation and blurring of components as is found in the case of He. At the same time, in analogy with He, large intensity changes occur, *i.e.,* strong fluctuations of the series lines of H and increased excitation of its band spectrum. J. E. K.

229. Rotational Raman Scattering in Benzene. S. Bhagavantam. *Indian Acad. Sci., Proc.* 2*A. pp.* 342–344, *Oct.,* 1935.—A study of the intensity distribution in the rotation wing accompanying the Rayleigh lines in liquid benzene is made using a high dispersion spectrograph. The results are in perfect agreement with those obtained on earlier occasions using instruments of lower dispersion [See Abstracts 2054 (1934) and 3530 (1935).] AUTHOR.

230. Polarisation of Raman Radiation. W. Hanle and F. Heidenreich. *Zeits. f. techn. Physik,* 16. 11. *pp.* 457–459, 1935. *Phys. Zeits.* 36. *pp.* 851–855, *Dec.* 1, 1935.—The polarisation of the edges of the Rayleigh lines scattered by liquids shows the presence of a broadening agency other than that of the rotation-broadening. If the broadening were due to rotations, the ratio of reversed circular polarisation to original circular polarisation ("reversal factor") should be 6. In toluene, for example, it is found to be 1·7. The Placzek theory gives for the reversal factor $U - \rho_n/(1-\rho_n)$, where ρ_n is the depolarisation for natural, linearly polarised light. This is confirmed for the strongly linearly polarised lines, but is not so for the depolarised (reversed circularly polarised) lines. Discrepancies occur outside experimental error. The Raman lines as well as the Rayleigh lines may be complex, having the centre originally circularly polarised, the edges reversed circularly polarised. The existence of a dispersion of polarisation found by Sirkar is claimed to have been disproved. Finally, for a number of different chlorine compounds the frequencies are classified on the evidence of the circular and linear polarisations and the frequencies. A. C. M.

231. Raman Spectra of the Isotopic Molecules H_2, HD, and D_2. G. K. Teal and G. E. MacWood. *J. Chem. Phys.* 3. *pp.* 760–764, *Dec.*, 1935.—The Raman spectra of H_2, HD and D_2 gases, at 3 atmospheres pressure, are excited by Hg 2537 and photographed with a high dispersion quartz prism spectrograph and 42 lines are analysed. The positions of the pure rotation lines for H_2 agree with the measurements of Rasetti but the lines in the *Q* vibration band do not. New vibrational constants calculated from the Raman and emission spectrum data of H_2 and HD give calculated values of the positions of the rotational-vibration Raman lines in good agreement with the values observed for the three isotopic molecules. Contrary to the theoretical predictions, the 0,0 line of the *Q* vibrational band of HD is observed. A source of error in Raman measurements, namely, the movement of the spectrum due to variations of the barometric pressure during the exposure of a plate, is detected and eliminated. AUTHORS.

232. Raman Spectra of Methyldiethyl Carbinol, Dimethylbenzylcarbinol, and Corresponding Ethylenic Compounds. J. Savard. *Comptes Rendus*, 201. *pp.* 833–835, *Nov.* 4, 1935.—A list is given of the Raman lines observed, and some of them are attributed to radicals C_6H_5, CH_2, CH. A. C. M.

233. Cis-Trans Isomerism in Methylcyclohexanols. J. Tabuteau. *Comptes Rendus*, 201. *pp.* 897–898, *Nov.* 12, 1935.—The difference between the Raman spectra of *cis-trans* forms of the three (*o*—, *m*— and *p*—) methylcyclohexanols is greatest in the frequency range 300–900 cm.$^{-1}$. The spectrum of the *cis*-alcohol and of its corresponding acetate contain a number of lines in common. In the *trans*-case the lines in common are fewer. A. C. M.

234. Raman Spectra of Glasses. T. G. Kujumzelis. *Zeits. f. Physik*, 97. 9–10. *pp.* 561–569, *Nov.* 12, 1935.—The Raman spectra have been recorded for 7 different glasses and for crystalline quartz, in the form of rods. Each glass is found to have an individual spectrum, composed partly of sharp, partly of very broad lines. There is no simple connection between the glass-spectra and the spectrum of SiO_2. It is remarkable that the line 800 cm^{-1}. occurs in a silicon-free glass, and can therefore not be claimed to arise from SiO_2. A. C. M.

***235. Absorption Tube for Gases in the Photographic Infra-Red. R. M. Badger, L. G. Bonner and P. C. Cross.** *J.O.S.A.* 25. *pp.* 355–356, *Nov.*, 1935.—An absorption cell of novel design is described, which combines the advantages of long path and relatively small volume. AUTHORS.

***236. Polarisation-Interference Phenomena in Quartz Spectrographs. J. W. Ellis and J. Kaplan.** *J.O.S.A.* 25. *pp.* 357–360, *Nov.*, 1935.—A detailed study is made of the polarisation-interference effects produced by quartz spectrographs, particularly those employing Littrow mounting. In general, the observed phenomena may be explained by assuming that the reflecting quartz prism acts as a thick wave plate. A. H.

***237. Hydrogen Lamp and Microphotometer for Ultra-Violet Absorption Spectra. H. C. Gull and A. E. Martin.** *Journ. Sci. Instruments,* 12. *pp.* 379–388, *Dec.*, 1935.—Apparatus for recording absorption curves is described. A hydrogen lamp giving a constant output is used to provide a continuous spectrum in the ultra-violet, and absorption spectra are photographed with this light source. One exposure suffices for the solution, and this is followed by a number of exposures for the solvent, starting with that given for the solution and then decreasing by amounts calculated to give a suitable range of extinction coefficients. The absorption spectrum together with the other spectra are recorded with a microphotometer in such a way that the absorption curve is traversed by a series of lines corresponding to known extinction coefficients. It is then possible to read directly from the record the extinction coefficient appropriate to any point on the absorption curve. The microphotometer is of simple design and is fully described. AUTHORS.

238. Variation of Detonation Spectra with the Nature of the Surrounding Gas. A. Michel-Lévy and H. Muraour. *Comptes Rendus,* 201. *pp.* 828–830, *Nov.* 4, 1935.—The spectrum of the light emitted when a mixture of tetranitromethane and toluene is exploded in various surrounding gases is studied. The results support the hypothesis that the luminosity is due to the excitation, by the explosion wave, of the molecules of the surrounding gas. [See Abstract 2181 (1935).] C. B. A.

See also Abstracts 10, 140, 170, 260, 285, 332.

VISION.

239. Glare Effects from a Number of Glare Sources. B. H. Crawford. *Phys. Soc., Proc.* 48. *pp.* 35–37, *Jan.* 1, 1936.—The effect of a number of glare sources on indirect vision, 5° above the fovea, is shown to be equal to the sum of their separate effects, the criterion of equality being that the equivalent background brightness of all the sources measured together is the same as the sum of the equivalent background brightnesses measured separately. AUTHOR.

See also Abstracts 155, 156, 164, 193.

X-RAYS.

240. Discontinuous Variation with Scattering Angle in the Scattering of X-Rays. J. Laval. *Comptes Rendus,* 201. *pp.* 889–891, *Nov.* 12, 1935.—The intensities of X-rays scattered from crystals is studied in directions not associated with selective reflections. The intensities are found to vary discontinuously as the direction of observation is changed. Between the discontinuities the variation is regular with the angle, but at the point of discontinuity the intensity varies by as much as 40 %. Experiments on metal powders reveal regularities in the appearance of the discontinuities, and two laws relating their position with the wave-length of the incident radiation and with the atomic number of the element respectively are proposed. C. B. A.

See also Abstracts 38, 339, 340.

HEAT.

CALORIMETRY.

241. Specific Heats of Aqueous Solutions of Potassium Chloride. C. J. B. Clews. *Phys. Soc., Proc.* 48. *pp.* 95–99, *Jan.* 1, 1936.—The specific heats of aqueous solutions of KCl have been measured between 15° C. and 45° C., over a range of concentration 0·1*N* to 2·5 *N*. The method of measurement employed was that devised by Ferguson and Miller [see Abstract 2470 (1933)] slightly modified for use with conducting liquids. AUTHOR.

242. Specific Heats of Iron Nitrides. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 608. *pp.* 135–139, *Nov.*, 1935. *In English.*—The Fe-N_2 series of alloys are prepared and their mean specific heat determined between 0° C. ∼ 99·7° C., by means of the ice calorimeter with evacuated wall. A curve indicating the relationship between specific heat and N_2 content is obtained and reveals a maximum. The meaning of this maximum is made clear and from the curve the results 0·124 2 for Fe_4N and 0·134 3 for Fe_2N were obtained. AUTHOR.

243. Molecular Heats of Pd-Sb Alloys. T. J. Poppema and F. M. Jaeger. *K. Akad. Amsterdam, Proc.* 38. 8. *pp.* 822–833, 1935.—A redetermination of the specific heat of Sb between room-temperature and 600° C. is made and the transformation point previously reported at 413° C. is found to be non-existent. The deviations of the specific heat of the alloys from the additive rule do not amount to more than a few per cent. L. G. C.

244. Molecular Heat of the Compound $PtSb_2$. T. J. Poppema and F. M. Jaeger. *K. Akad. Amsterdam, Proc.* 38. 8. *pp.* 833–836, 1935.—Measurements are made between room-temperature and 600° C. Deviations from the additive rule are found, in the sense that the molecular heat of the compound is smaller than that calculated from the atomic heat of the components. L. G. C.

245. Molecular Heats of Supposed Cu-Pd Compounds. T. J. Poppema and F. M. Jaeger. *K. Akad. Amsterdam, Proc.* 38. 6. *pp.* 836–841, 1935.—Measurements are carried out over a temperature range from room-temperature to 900° C. L. G. C.

See also Abstracts 57, 252, 259.

CONDUCTION.

246. Accommodation Coefficient of Hydrogen on Iron. H. H. Rowley and W. V. Evans. *Am. Chem. Soc., J.* 57. *pp.* 2059–2064, *Nov.*, 1935.—The accommodation coefficient of H_2 on a bright iron surface saturated with H_2 is determined for the temperature range 120–450° K. and found to be 0·31 at the higher temperatures and rising steadily below 350° K. to 0·55 at 120° K. This rise with decreasing temperature is compared with similar results obtained with Pt and W surfaces and discussed on the basis of two distinct types of adsorbed H_2. Comparison of the accommodation coefficients obtained by numerous investigators on different surfaces leads to the conclusion that the exchange of energy between H_2 gas and an adsorbed layer of H_2 was measured in each case. An attempt to remove this adsorbed layer lowers the accommodation coefficient from 0·31 to 0·18 at 350° K. AUTHORS.

247. Law of Heat Conduction in Moving Media. M. Lang. *Ann. d. Physik,* 24. 5. *pp.* 393–408, *Nov.,* 1935.—The application of Fourier's theory to determine the temperature field in a flowing medium leads to a spreading out of the heat to infinity against the direction of flow of the medium. This is contrary to our experience of a finite velocity of heat propagation and to the result given by optical methods. The explanation is that Fourier's law assumes a continuous medium, whereas the heat conduction process considered is due to molecular movements. The heat conduction equation which is obtained when the molecular structure of the material is allowed for gives results in agreement with experiment. R. W. P.

See also Abstract 44.

CONVECTION.

248. Heat Transmission by Free Convection at a Square Plate. R. Weise. *Forsch. IngWes.* 6. *pp.* 281–292, *Nov.–Dec.,* 1935.—A full description of a new method for the determination of heat transmission by convection from the surface of square plates, both in the direction parallel to the surface, around the edges or sides, and also in the direction perpendicular to the surface of the plate. Two Al plates of dimensions $160 \times 160 \times 10$ mm^3. and $240 \times 240 \times 15$ mm^3. respectively, were tested over the temperature range of 50° to 350° as excess temperature. From a comparison with the total heat given out by the plate stationary keeping the experimental conditions the same, the heat loss by radiation was determined and that due to convection deduced. For the perpendicular direction the transmission agreed with the Schmidt and Beckmann formula, $a = 4\cdot80 \times \sqrt[4]{(T_w - T_r)/T_r \cdot H}\sqrt{B/760}$, for a plane surface by substituting 6·12 for their value of 4·80. Similarly for Nusselt's formula the heat exchange is derived by substituting the factor 2·0 for small and 2·3 for large plates in place of the Nusselt value 2·2. Dimensionally, the Jakob and Linke curves are followed. For thin plates the temperature-field-distribution for surface temperatures of 149° and 246° was measured and found to be of a similar character at both temperatures. Full experimental and theoretical details are appended. S. G. B.

249. Heat Transfer and Diffusion. W. Hoffmann. *Forsch. IngWes.* 6; *pp.* 293–304, *Nov.–Dec.,* 1935.—It is shown that the heat transfer from a surface to a gas can be deduced from a knowledge of the material transfer in the analogous diffusion case. Experiments are described in which the surface under test is covered with paper moistened with phosphoric acid and subjected to streams of ammonia gas having various velocities. The rate of diffusion to elemental sections of the surface is deduced from a determination of the amount of ammonium phosphate formed, and the distribution of heat transfer is ultimately derived. The cases for which equations for the heat transfer have been determined include a plane surface subjected to a tangential wind; a small plate inclined at various angles to the wind stream; a cylindrical tube having the fluid flowing parallel to the axis either externally or internally; and various arrangements of batteries of tubes. R. W. P.

250. Heat Transfer in Tubes at High Reynolds Numbers. K. Winkler. *Forsch. IngWes.* 6. *pp.* 261–268, *Nov.–Dec.,* 1935.—The heat transfer due to turbulent flow in a drawn brass tube 50 mm. long has been measured, for a Prandtl number of about 3, over a range of Reynolds numbers extending up to 500,000. Previous determinations had only been made up to Re = 110,000, but the new results indicate that for most practical purposes Kraussold's equation can be applied over the entire range. R. W. P.

251. Heat Transfer over the Surface of a Body Immersed in a Flowing Liquid. G. Krujilin and B. Schwab. *Techn. Phys., U.S.S.R.* 2. 4. *pp.* 312–323, 1935. *In English.*—Reviews the various experimental methods which have been used to determine the variation of the heat transfer coefficient around the surface of a heated cylinder when subjected to a wind stream at right angles to its axis. It is then shown that this coefficient can be determined directly from surface temperature measurements together with a knowledge of the solution of Laplace's equation for the particular case. This solution is given for a hollow infinite cylinder and for a hollow sphere, and the necessary surface temperature measurements are determined for the former case. After allowance is made for radiation the results obtained for the heat transfer by forced convection are seen to be in general agreement with those of other workers. R. W. P.

See also Abstract 88.

DILATATION.

See Abstract 44.

MELTING AND BOILING POINTS.

252. Isotopic Shift of Water by Distillation. J. Horiuti and G. Okamoto. *Chem. Soc. Japan, Bull.* 10. *pp.* 503–505, *Oct.*, 1935.—The isotopic shift in a heavy water sample of 2·60 % deuterium content is determined on slow vacuum distillation over the temperature range 0·05 to 21°, the heterogeneous equilibrium studied being $H_2O_{vap} + HDO_{liq}\text{-}xH_2O_{liq} = HDO_{vap} + H_2O_{liq}\text{-}xH_2O_{liq}$; the measured shift of the distillate gives directly the equilibrium constant of the reaction. The difference between partial molar heat of vaporisation for HDO and H_2O is calculated from the temperature variation of the equilibrium constant as -215 ± 24 cal., and is correlated with spectroscopic data. N. M. B.

***253. Combined Hydrogen and Helium Liquefier. B. V. Rollin.** *Phys. Soc., Proc.* 48. *pp.* 18–27, *Jan.* 1, 1936.—A description is given of a helium liquefier which needs only liquid air for the initial cooling and is designed to enable low-temperature experiments to be made in the ordinary laboratory. AUTHOR.

See also Abstracts 3, 254.

TEMPERATURE, MEASUREMENT OF.

***254. Low-Temperature Fixed Points by Hydrogen Thermometer. S. Aoyama and E. Kanda.** *Chem. Soc. Japan, Bull.* 10. *pp.* 472–481, *Oct.*, 1935.—A constant volume hydrogen gas thermometer is described and its accuracy as a low-temperature standard investigated. It is considered that the possible error decreases from ±0·036° C. at 0° C. to ±0·025° C. at −200° C. The instrument is used to determine the following fixed points, the boiling points of O_2 and N_2, and the sublimation point of CO_2. It is also used for the calibration of a Cu constantan thermocouple over the range 0° C. to −200° C. R. W. P.

***255.** **Improved Thermo-Regulator and Circuit for D.C. Supply. S. J. Folley and P. L. Temple.** *Journ. Sci. Instruments,* 12. *pp.* 392–393, *Dec.,* 1935.—An improved form of thermo-regulator, having a large surface-volume ratio of toluene bulb, and a mercury seal at either end, is described. A circuit employing a pentode valve is used in conjunction with a relay to reduce sparking at the mercury surface to a minimum. A water-bath at ordinary temperatures can readily be maintained constant to within 0·01° C. AUTHORS.

THERMOCHEMISTRY.

256. Energy of Dissociation of Carbon Monoxide. P. Goldfinger, W. Lasareff and B. Rosen. *Comptes Rendus,* 201. *pp.* 958–960, *Nov.* 18, 1935.—After discussing the various methods of determining D_{CO} (the energy of dissociation of CO) into normal atoms, and L_C (the heat of sublimation of C at 0° Abs.) it is concluded that $D_{CO} = 9 \cdot 10$ eV and $L_C = 123 \cdot 6$ k.cal. are the only values consistent with those deduced from them for D_{CO_+} (6·1 eV), D_{CN} (5·8 eV), and the mean energy of each C-H link in CH_4 (110 k.cal.) [See Abstract 3561 (1935)]. C. A. S.

257. Induction Period in Gaseous Thermal Explosions. O. K. Rice, A. O. Allen and H. C. Campbell. *Am. Chem. Soc., J.* 57. *pp.* 2212–2222, *Nov.,* 1935.—When the differential equation connecting temperature with time in an exothermic gas reaction is integrated, a sudden temperature rise, corresponding to an explosion, is found to be indicated above a certain sharply defined pressure. From curves of this type, an approximate method for calculating the induction period in thermal explosions is obtained, and is applied to the explosions of azomethane and ethyl azide. Rough values of the heats of decomposition of these compounds are thereby obtained. A discussion is given of the rate at which a gas not reacting exothermically comes into thermal equilibrium when admitted to a heated vessel. AUTHORS.

See also Abstracts 238, 252.

THERMODYNAMICS.

258. Negative Cohesion Pressure. W. Jacyna, S. Derewjankin, A. Obnorsky and T. Parfentjew. *Zeits. f. Physik,* 97. 11–12. *pp.* 774–776, *Nov.* 25, 1935.—Recently, P. Weiss [see Abstract 3111 (1935)], P. W. Bridgman and others, have revised the van der Waals equation of state and their results are now shown to be favourable to the Jacyna theory, whereby it was shown that at sufficiently high temperatures the negative van der Waals a-values, *i.e.,* the negative cohesion pressures, occur in all gases. H. H. Ho.

259. Heat Capacity, Entropy, and Free Energy of Rubber Hydrocarbon. N. Bekkedahl and H. Matheson. *Bureau of Standards, J. of Research,* 15. *pp.* 503–515, *Nov.,* 1935.—Measurements of heat capacity are made on rubber hydrocarbon in its different forms from 14 to 320° K. with an adiabatic vacuum-type calorimeter. At 14° K. the heat capacity is found to be 0·064 j./gm./° C. for both the metastable amorphous and the crystalline forms. With increase in temperature, the heat capacity increases gradually up to a transition at about 199° K., the amorphous form having a little the greater value. At 199° K. both forms undergo a transition of the second order, the heat capacity rising sharply.

For the amorphous form above this transition the heat capacity rises gradually without discontinuity to the highest temperature of the measurements. The crystalline form undergoes fusion (a transition of the first order) at 284° K., the heat of fusion being 16·7 j./gm. At 298·1° K. the heat capacity of the rubber is $1\cdot880 \pm 0\cdot002$ j./gm./° C. Utilisation of the data according to the third law of thermodynamics yields $1\cdot881 \pm 0\cdot010$ j./gm./° C. for the entropy of rubber at 298·1° K. Combination of these with appropriate other data on entropies and heats of reaction yields $1\cdot35 \pm 0\cdot10$ kj./gm. for the standard free energy of formation at 298·1° K. of rubber from carbon (graphite) and gaseous hydrogen. AUTHORS.

260. Thermodynamic Properties of Sulphur Compounds. Part II. SO_2, CS_2 and COS. P. C. Cross. *J. Phys. Chem.* 3. *pp.* 825–827, *Dec.*, 1935.—The thermodynamic properties of SO_2, CS_2 and COS are calculated from the molecular constants obtained by electron diffraction [see Abstract 23 (1936)], and from Raman and infra-red spectra. $-(F^0 - E_0^0)/T_{298\cdot1} = 50\cdot95, 48\cdot28, 47\cdot39$; $S^0_{298\cdot1} = 59\cdot40, 56\cdot84, 55\cdot34$ for SO_2, $CS_2(g)$, and COS, respectively. The results are applied to several reactions involving these compounds. The free energies of formation of $CS_2(l)$ and COS at 298·1° K. are + 15·24 and − 40·48 k.cal. [For Part I see Abstract 1747 (1935).] AUTHOR.

See also Abstracts 100, 301.

VAPOUR PRESSURE.

261. Vapour Pressures of Alkyl Sulphides. H. W. Thompson and J. W. Linnett. *Faraday Soc., Trans.* 31. *pp.* 1743–1747, *Dec.*, 1935. —The vapour pressures of some alkyl sulphides and ethyl mercaptan are determined at a series of temperatures below the boiling-point. The values of the Trouton constant are calculated from the data and inferences drawn in regard to the association of the substances in the liquid state. AUTHORS.

See also Abstracts 3, 106, 150.

ACOUSTICS.

262. Parametric Coupling between Stationary Acoustical Waves. G. Gorélik. *Techn. Phys., U.S.S.R.* 2. 2–3. *pp.* 248–251, 1935. *In French.*—The author studies the anomalous introduction of subharmonics in the stationary wave pattern in certain types of enclosures when driven with a constant frequency. This is explained by non-linear coupling parameters, the mathematical theory of which has been previously applied to pendulums. L. E. C. H.

***263. Forced Vibrations of a Circular Plate with a Free Edge. R. Schünemann.** *Ann. d. Physik,* 24. 6. *pp.* 507–535, *Nov.,* 1935.—A circular aluminium plate is caused to vibrate by an oscillating force applied eccentrically, the resulting vibrations are examined by an electrical method, a small surface of the plate forming one plate of a condenser from which is produced an oscillating potential, which can be examined electrically for phase and amplitude. Measurements show that the phase change across nodal lines does not occur in jumps but alters gradually, the curve being steeper near resonance frequencies. At resonance, stationary waves are formed, but as the frequency is displaced from resonance the nodal lines spread out becoming nodal zones and the waves become progressive. Finally, if the plate is loaded at points of greatest amplitude, the form of the tone figures and the resonance frequencies are changed. H. M. B.

***264. Measurement of Small Amplitudes of Vibration. G. F. Partridge.** *Phil. Mag.* 20. *pp.* 953–963, *Nov.,* 1935. *Supplement.*—The paper describes a modification of Bragg's method [see Abstract 3379 (1929)] in which, by substituting a rigid pendulum for a reed, it is possible to measure amplitudes of the order of 10^{-6} cm. with an accuracy of a few per cent. By using a quartz strip vibrator at acoustic frequencies, the amplitudes measured can be verified by calculation. G. E. A.

265. Acoustic Radiation Pressure on Circular Discs: Inertia and Diffraction Corrections. L. V. King. *Roy. Soc., Proc.* 153*A*. *pp.* 1–16, *Dec.* 2, 1935.—This paper is of chief interest to those concerned with the measurement of supersonic radiation fields in liquids, since the calculations show that in a progressive wave in air the intensity would need to be greater than 100 db before it would be possible to observe the radiation pressure. It is shown that a disc, which for this purpose would be attached to a suitable torsion balance, would, besides the principal deflection, undergo oscillations perpendicular to its plane. Only a thin disc is considered in the calculations, though a method similar to that used in another paper [see following Abstract] could be used for discs of finite thickness. After allowing for diffraction effects the force per unit area on a disc whose circumference is small compared with the wave-length, situated in a plane progressive wave, is calculated as being approximately $16/27\pi^2 \times (\kappa a)^4 \times F_p(\rho_0/\rho_1) \times \hat{E}$, where $\hat{E}$ = mean total energy density in the medium and $F_p(\rho_0/\rho_1)$ is the inertia factor corrected for diffraction. Calculations are also made for a disc situated in a plane stationary wave field, and it is shown that the radiation pressure is in this case of a very much higher order than in a progressive wave. J. E. R. C.

266. Inertia and Diffraction Corrections for the Rayleigh Disc. L. V. King. *Roy. Soc., Proc.* 153*A*. *pp.* 17–40, *Dec.* 2, 1935.—The usual Rayleigh formula for the couple on a Rayleigh disc is based upon the hydrodynamical theory of the couple exerted on an oblate spheroid suspended in a stream of incompressible fluid of uniform velocity. The present paper is concerned with obtaining a formula which can more correctly be applied to acoustical measurements, and for this purpose the couple on a rigid disc with finite thickness suspended in a plane progressive sound wave is calculated. It is shown that in this case the disc performs small oscillations along its normal owing to the first order radiation pressure and also angular oscillations about its axis of suspension. The first effect leads to the introduction into the Rayleigh equation of a term $m_1/(m_1 + m_0)$, where m_1 = mass of the disc and m_0 = its hydrodynamic mass. A similar term arises from a consideration of the angular oscillations. A consideration of the diffraction effects is also made, and a set of integral equations having a discontinuous kernel is obtained and solved. The formula obtained for the mean torque on the disc in a plane progressive wave is:

$$-\tfrac{2}{3}\rho_o a^3 \sin 2\alpha |A\kappa|^2 \left[\frac{m_1\{1+\frac{2}{5}(\kappa a)^2\cos^2\alpha\}}{m_1 + m_o\{1+\frac{1}{5}(\kappa a)^2\}} - \tfrac{2}{15}(\kappa a)^2 \frac{I_1}{I_1+I_o}\cos 2\alpha\right],$$

where $|A\kappa|$ is the velocity amplitude, and I_1, and I_0 are the moment of inertia and hydrodynamic moment of inertia respectively. The couple on a disc when suspended in a plane stationary wave field is also calculated and given as:

$$-\tfrac{2}{3}\rho_o a^3 \sin 2\alpha |A\kappa|^2 \left[\sin^2\kappa h.\frac{m_1\{1+\frac{2}{5}(\kappa a)^2\cos^2\alpha\}}{m_1+m_o\{1+\frac{1}{5}(\kappa a)^2\}} - \tfrac{2}{15}\cos^2\kappa h.\frac{(\kappa a)^2 I_1}{I_1+I_o}\cos 2\alpha\right],$$

where h is the distance measured from the centre of the disc along the direction of propagation. This shows that the couple when the disc is situated at the nodes is smaller and opposite in sign to that when it is at the anti-nodes. The optimum thickness of the disc is calculated and given by $0 \cdot 62\, a\, \rho_0/\rho_1$, where a = radius of the disc and ρ_0 and ρ_1 are the densities of the medium and disc respectively. [See preceding Abstract.]

J. E. R. C.

267. Vibrations of Air and CO_2 in Closed Spherical Resonators. K. Voeckler. *Ann. d. Physik*, 24. 4. *pp.* 361–376, *Oct.*, 1935.—A method is described by which the frequencies and decrements of the natural tones of air and CO_2 in a closed spherical resonator are investigated. Vibrations are excited by a telephone membrane in the wall of the resonator, and are received by another membrane diametrically opposite the first, and recorded photographically. The frequency and damping are determined from the curves so obtained. With metal spheres vibrations of the walls cause disturbances in the records, but good results are obtained with hollow spheres of plaster of Paris. Air, CO_2 and mixtures of the two gases are tested, and a series of frequencies corresponding to the spherical functions of the orders 1 to 6 is measured. The frequency of zero order cannot be excited by the above method. The measurements are in good agreement with the Rayleigh-Thiesen theory as regards the frequencies; the observed damping is of the same order of magnitude as the theoretical value.

G. E. A.

268. Conductivity of an Orifice in the End of a Pipe. A. E. Bate. *Phys. Soc., Proc.* 48. *pp.* 100–101, *Jan.* 1, 1936.—The conductivity of an orifice in an infinite plane of negligible thickness was shown by the late Lord Rayleigh to be equal to its diameter *d*. The writer extended this formula [see Abstract 915 (1931)] to include the conductivity when one side of the plane is enclosed by a concentric pipe of diameter *D*, which thus forms a cylindrical resonator fitted with an infinite plane at the mouth, and deduced the expression $d \cdot 2^{d/D}$ for the conductivity. This expression is supported by experimental results quoted in the present paper. [See also Abstract 5149 (1934).] AUTHOR.

269. Change of Velocity of H.F. Sound with Pressure. E. J. Pumper. *Phys. Zeits. d. Sowjetunion,* 8. 3. *pp.* 300–310, 1935. *In German.*—Measurements of the variation of the velocity of sound in dry air and CO_2 as the pressure is varied are made using sound of a frequency of $4 \cdot 4 \times 10^4 \sim$. The velocity increases with decreasing pressure, a change of 0·65 % in the case of air and 2·2 % in the case of CO_2 being observed for a pressure change from atmospheric to 1/50 atmosphere. Possible explanations of the results are discussed. J. E. R. C.

270. Diffraction of Light by Stationary Ultrasonic Waves in Liquids. R. Bär. *Helv. Phys. Acta,* 8. 7. *pp.* 591–600, 1935. *In German.*—Experiments are described to determine which of the spectra diffracted by stationary ultrasonic waves in liquids are coherent, *i.e.*, can be made to interfere with each other. It is found that any pair of spectra of even order (except zero order) are in part, at least, coherent. The same is true for any pair of spectra of odd order. On the other hand any spectrum of the first group is completely incoherent with a spectrum of the second group. The photographs which are obtained when some or all of the diffracted spectra are superposed can be explained on the basis of these coherence relations. The experimental results on coherence are exactly what would be expected on Brilliouin's theory that the higher orders occur through multiple scattering. J. E. R. C.

***271. Reverberation Meter Based on the Hand-Clap Method of Estimating Reverberation Time. J. C. Cotton.** *Rev. Sci. Instruments,* 6. *pp.* 344–346, *Nov.,* 1935.—An apparatus which can be used for rough determinations of reverberation periods and also is useful for experimental demonstrations is described. It consists of a neon lamp, on the end of a whirling arm, which is connected to a microphone and amplifier. Coupled to the whirling arm is a commutator which discharges a condenser through a loud-speaker once per revolution. While the sound level is above a certain amount the neon lamp remains alight. Hence after each click from the loud-speaker the lamp remains alight for an interval determined by the reverberation characteristics of the room in which it is placed. The amount of this interval can be seen from the length of the arc of light which appears as the whirling arm rotates. J. E. R. C.

272. Newer Concepts of the Pitch, Loudness and Timbre of Musical Tones. H. Fletcher. *Frank. Inst., J.* 220. *pp.* 405–429, *Oct.,* 1935.—From a consideration of the three auditory sensations it is concluded that the loudness of a musical tone depends on its intensity, frequency and overtone structure, its pitch depends on frequency and loudness, and its timbre may be changed by large changes in intensity and frequency. The establishing of a true scale of loudness is described, and leads to the following law: If p_0 is the initial pressure and p the pressure to reduce the loudness from N_0 to N, then $N/N_0 = \sqrt[3]{(p/p_0)^2}$. Curves are given for the relation between r.m.s. pressure and loudness for pure tone frequencies from 50 to 17,000. Tones with frequencies 800 to 2000 have approximately the same loudness when the r.m.s. pressures are the same. Similar sets of curves are drawn for tones having ten equally intense components. A tone of frequency 100 was sounded so as to give a pressure variation of about 1/10 dyne. The harmonics were then added and the intensity decreased tenfold. On listening to the two tones alternately, the second was found to be much louder than the first. Hence the loudness of a tone can be increased by increasing its overtone content. Practically all the loudness of the tones of piano strings of low pitch is due to the higher overtones. [See also Abstract 5386 (1933).] G. E. A.

273. Pitch Recognition. W. Bürck, P. Kotowski and H. Lichte. *E.N.T.* **12.** *pp.* **326–333,** *Oct.*, **1935.**—The authors determine experimentally the minimum time during which a given pure tone of varying frequency must be applied to the ear in order that its pitch can be recognised. The data are studied mathematically and the periods calculated from theoretical assumptions. It is concluded that a tone is identifiable if in its energy spectrum the energy content within about ± 2 % of its ultimate frequency amounts to between 1/3 and 1/10 of the total. L. E. C. H.

274. Sound Absorption by Porous Walls. L. Cremer. *E.N.T.* **12.** *pp.* **333–346,** *Oct.*, **1935.**—A former paper on this subject [see Abstract 4175 (1933)] gave a simple approximate theory. The present paper develops the theory in greater detail. The acoustic properties of porous walls are represented by the two constants "porosity" and "specific current-resistance." Observations of these quantities by different experimenters have shown that the porosity varies only slightly from one sound absorber to another, whereas the current-resistance varies over a very wide range, the highest observed value being of the order of the tenth power of the smallest. The paper is mainly mathematical and does not permit of concise abstraction. A. B. W.

***275. Simple Stroboscope. A. J. O'Leary.** *J.O.S.A.* **25.** *pp.* **375–380,** *Nov.*, **1935.**—A method of producing a stroboscopic effect is described in which a rotating slit of light replaces the intermittent illumination usually employed. The lamp is mounted along the axis of a cylinder and the slit is cut diametrically in the end of the cylinder. When the slit turns with its centre of rotation coinciding with that of a rotating disc, at such a speed that it meets the same part of the disc in the same place in successive rotations, then a stationary image results. Since the light is always shining on some part of the disc high intensity of illumination is obtained without loss of detail. Light from a slit parallel to the axis of rotation (*i.e.*, cut longitudinally along the cylinder wall) may be used for viewing vibrating bodies such as springs or tuning forks. Various effects are discussed in detail. A. H.

276. Motion of Water Drop in Acoustic Field. S. W. Gorbatschew and A. B. Severny. *Kolloid. Zeits.* **73.** *pp.* **146–154,** *Nov.*, **1935.**—Two small drops of a weak solution of H_2SO_4 hung from separate thin glass fibres within a ⊥-shaped tube in the horizontal part of which stationary sound waves could be set up. The two cases were observed in which the line joining the centres of the drops was (i) perpendicular, (ii) parallel to the direction of the sound waves. The sound waves caused a displacement of the drops, and also a vibration of the drops round the fibres. For frequencies within a certain range the two drops coalesced. The observations were repeated in a 15 cm./sec. air-current and in both hydrodynamic and acoustic fields there was attraction when the drops were in the perpendicular position, and repulsion when in the parallel position. Starting from Bjerknes' theory the authors determine qualitatively the character of the elementary processes underlying the motions of the drops. G. E. A.

See also Abstracts 116, 137.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

277. A.C. and D.C. Conductivity of the Bunsen Flame. H. Ullmann. *Zeits. f. Physik*, 97. 7–8. *pp.* 496–510, *Oct.* 25, 1935.—The resistance of a condenser made of two vertical Pt electrodes placed in a Bunsen flame is measured with a.c. of frequency $1 \cdot 59 \times 10^6 \sim$, and the conductivity calculated from this compared with that found by a d.c. method. The measurements are made both with pure flames and with those in which salts are placed. A.c. and d.c. methods are found to be equally accurate. Interesting conclusions are drawn as to how far the disturbance caused by the electrodes extends into the inside of the condenser. R. L.

278. Mechanism of Static Spark Breakdown. R. N. Varney, H. J. White, L. B. Loeb and D. Q. Posin. *Phys. Rev.* 48. *pp.* 818–822, *Nov.* 15, 1935.—The mechanism of spark breakdown has been investigated largely by the study of the deviations of the pre-spark current from the simple electron ionisation law, $i = i_0 e^{\alpha d}$. The deviations indicate for large separations a current greater than that given by the formula. It is suggested that the increased current is not due to new ionisation processes, but to distortion of the spark gap field by space charge, giving an apparent increase in α, which is a function of the field strength. Analysis of previous experimental results shows that for small fields α increases exponentially with the field strength; for larger fields, α increases with the square of the field strength, while for very large fields α becomes more nearly constant. A solution of Poisson's equation shows that these variations of α are to be expected on theoretical grounds. Space charge is the primary cause of spark breakdown in the low field range, but only in the case of high fields are the ordinary Townsend ionisation processes effective. J. E. R.

279. Ionisation and Breakdown of Gases. W. Rogowski and A. Wallraff. *Zeits. f. Physik*, 97. 11–12. *pp.* 758–764, *Nov.* 25, 1935.—It is shown experimentally that the lowering of electrical breakdown in gases by ionisation follows the square root law enunciated by Rogowski and Fucks [see Abstract 3132 (1935)] for small degrees of ionisation. When the ionisation becomes intense the breakdown lowering increases slowly and then as the 4th root of the ionisation current density. H. J. H. S.

280. Temperature Distribution and Electron Density in Open Electric Arcs. H. Hörmann. *Zeits. f. Physik*, 97. 9–10. *pp.* 539–560, *Nov.* 12, 1935.—Measurements were made of the field strength in freely burning and in stabilised electric arcs at atmospheric pressure. The results for the carbon arc show that the value hitherto accepted for the constant b in the Ayrton formula is about twice too high. Measurements with extremely pure carbons showed that the ionisation in the carbon arc is not appreciably affected by the presence of impurities in the carbons. From the intensity distribution of the spectral lines about the cross-section of the arc making use of Abel's integral equation, it was found possible to calculate the specific radiation density for the arc cross-section. This was done for the arc between pure carbons and for arcs between electrodes of the alkali metals. From the radiation density the temperature distribution over the arc cross-section was determined for the carbon arc.

From Saha's equation the degree of ionisation could then be found as a function of the temperature and the ionisation potential. In this way it was found that the temperature on the axis of the arc should be between 6000° and 7000° K., which is in agreement with the results of Ornstein. A. W.

***281. Diffusion Effects in the Negative Glow. H. Fischer and W. Weizel.** *Zeits. f. techn. Physik*, 16. 11. *pp.* 433–435, 1935. *Phys. Zeits.* 36. *pp.* 826–829, *Dec.* 1, 1935.—A discharge tube is described in which the anode consists of a large cylinder, and the kathode a small plate on the axis. A third electrode, consisting of a plate similar to the kathode is placed parallel to the kathode and 2 cm. away. Under the conditions used, this electrode is in the negative glow of the hydrogen discharge, and its potential can be varied between those of the anode and kathode. If the total discharge current is kept constant the current to the auxiliary electrode may be as much as 40 % of the total current without appreciably affecting the maintenance potential. If the auxiliary electrode current is greater than this the maintenance potential falls off. The results are discussed and the observed effects attributed to ionic diffusion. J. E. R.

282. Cloud-Chamber Investigation of Gas Discharge. E. Flegler and H. Raether. *Zeits. f. techn. Physik*, 16. 11. *pp.* 435–440, 1935. *Phys. Zeits.* 36. *pp.* 829–834, *Dec.* 1, 1935.—With a view to elucidating the theory of electrical breakdown in gases, the conditions of ionisation just preceding a gas discharge were investigated by means of a cloud chamber. Various types of electrode were used, from a point to plate system giving a very inhomogeneous field to a Rogowski electrode arrangement giving an almost homogeneous field. The development of the discharge is shown in a series of photographs. Curves are given showing the voltage-pressure relations and the connection between discharge length, time and voltage. When the field is uniform the discharge appears to start simultaneously at the anode and kathode; the usually accepted idea of an electron stream starting from the kathode as a preliminary to a discharge should therefore be accepted with reserve. J. E. R.

283. Probe Measurements in Discharges Varying with Time. W. Koch. *Zeits. f. techn. Physik*, 16. 11. *pp.* 461–466, 1935. *Phys. Zeits.* 36. *pp.* 855–860, *Dec.* 1, 1935.—Probe measurements were made first in a low pressure arc in mercury vapour, the arc being fed with a.c. of sine form, and secondly an investigation was made of the decay of the arc plasma on suddenly switching off the supply. 50 cycle a.c. was employed, and the probe measurements enabled the changes with time of the spacial potential and the electron temperature to be determined. Using a Braun tube it was found possible to investigate relatively rapid changes in discharge phenomena by means of current probes. Effects lasting only 10^{-5} sec. could be dealt with in this way. A. W.

284. Excitation Function of Mercury by Atomic Impact. K. Galler. *Ann. d. Physik*, 24. 5. *pp.* 421–439, *Nov.*, 1935.—The mutual excitation of H and Hg atoms is investigated by means of canal rays. H canal rays excite the Hg atoms alone; the H atoms are neither excited nor ionised. Excitation of Hg atoms at higher voltages is attributable practically entirely to neutral H atoms; excitation by protons is at least 20 times smaller. Excitation of Hg atoms by collision with neutral H atoms is compared with excitation by electronic impact. The phenomenon of mutual excitation is most simply interpreted in terms of the conception of transferable energy. J. S. G. T.

285. Energy Losses of Electrons in Helium, Neon and Argon. R. Whiddington and E. G. Woodroofe. *Phil. Mag.* 20. *pp.* 1109–1120, *Dec.*, 1935.—Energy losses suffered by electrons in collision with atoms of He, Ne and A have been determined by the magnetic spectrum method. A considerable higher order of accuracy than in previous work of this type has been attained. [See **Abstract 2683 (1935)**.] Below are given the experimental results and interpretations :—

Atom	Energy loss	Relative probability	Transition	Spectroscopic value
Helium ..	21·11 ± 0·03	10	$^1S_0 - 1s_2(^1P_1)$	21·11
	23·06 ± 0·06	2	$^1S_0 - 2s_2(^1P_1)$	22·97
	23·70 ± 0·10	1	$*^1S_0 - 3s_2(^1P_1)$	23·62
Neon ..	16·76 ± 0·02	16	$^1S_0 - 1s_2(^1P_1)$	16·76
	18·3	small	$^1S_0 - 2p_{10}(^3S_1)$	18·29
	18·62 ± 0·05	4	$*\left\{\begin{array}{l} ^1S_0 - 2p_4(^3P_2) \\ ^1S_0 - 2p_5(^1P_1) \end{array}\right.$	18·62 18·60
	18·9	small	$^1S_0 - 2p_1(^1S_0)$	18·87
	19·98 ± 0·06	5	$*^1S_0 - 3S_1(^1P_1)$	20·04
Argon ..	11·77 ± 0·03		$^1S_0 - 1s_2$	11·77
	12·91 ± 0·08		$^1S_0 - 2p_{10}$	12·84
	13·35 ± 0·07		$*\left\{\begin{array}{l} ^1S_0 - 2p_3 \\ ^1S_0 - 2p_1 \end{array}\right.$	13·23 13·41
	14·23 ± 0·03		$^1S_0 - 3s'_1$	14·23
	14·96 ± 0·09		$*^1S_0 - 4s'_1$	14·93
	15·28 ± 0·08		$*^1S_0 - 5s'_1$	15·27

* Interpretation uncertain.

J. E. R.

***286. Discharge-Tube Counters. A. v. Hippel.** *Zeits. f. Physik*, 97. 7–8. *pp.* 455–481, *Oct.* 25, 1935.—A systematic survey of the space charge conditions in a discharge between the striking and maintained states is made with a view to explaining the use of such a discharge as a particle counter. To make the survey more complete, current-voltage characteristics and the application of the Townsend law are first considered. The conditions under which a discharge becomes unstable, and the effect of introducing ionising particles are discussed. The range of applicability of the Paschen pressure-electrode separation rule is considered, and a new definition of breakdown potential given. By combining curves of breakdown and maintenance potential against electrode separation, the range of conditions under which a discharge may be used as a counter is demonstrated. Under conditions, which are specified, a tube may be used as a " proportional counter " or as an impulse counter. The theoretical considerations apply strictly to uniform field conditions, but the results are applied to the various types of counter in practical use. The effects of non-uniformity of field, gas pressure, polarity and electrode size, on the counting properties of tubes are considered in detail. J. E. R.

***287. Examination of the Tube Counter with the Braun Tube. A. Trost.** *Zeits. f. techn. Physik*, **16. 11.** *pp.* **407–410, 1935.** *Phys. Zeits.* 35. *pp.* 801–804, *Dec.* 1, 1935.—The form of the pulse and the time of discharge of a tube counter filled either with air or with argon are examined with a Braun tube. In contrast with accepted values, the time of discharge is found to be about 10^{-2} sec. Addition of alcohol vapour to the tube counter causes basic changes in the tube characteristics. The behaviour of a tube filled with alcohol alone is also investigated and attempts are made to give a theoretical explanation of the results. F. C. C.

***288. Simple Relay for the Greinacher Spark Counter. H. Teichmann.** *Zeits. f. techn. Physik*, 16. 11. *pp.* 414–416, 1935. *Phys. Zeits.* 36. *pp.* 808–810, *Dec.* 1, 1935.—An improved electrostatic mechanical relay for the Greinacher spark counter is described in which the usual water stream is replaced by a light steel trembler. F. C. C.

***289. Geiger-Counter Characteristics with Applied Potentials Reversed. D. B. Cowie.** *Phys. Rev.* 48. *pp.* 883–885, *Dec.* 1, 1935.—The paper describes experiments made with Geiger-Müller counters in which the cylinder potential is positive with respect to the wire instead of negative as ordinarily used. The counter operates under reduced efficiency with this reversed condition. When used as a double coincidence set the reduction in efficiency is greater than for a single counter. The paper also describes experiments confirming a view that the inefficiency of the reversed counter may be explained by supposing the counter action to be produced when a positive ion strikes the wire and liberates from it a secondary electron. Whenever such an electron is liberated a discharge takes place, but the probability of liberation is low. However, it seems reasonable that the probabilities of such liberation of secondary electrons as found by Penning and others stands in agreement with the efficiency observed in the counter experiments cited above. AUTHOR.

***290. High-Current Ion Sources for Nuclear Investigations. E. S. Lamar, E. W. Samson and K. T. Compton.** *Phys. Rev.* 48. *pp.* 886–892, *Dec.* 1, 1935.—The capillary ion source described by Tuve, Dahl and van Atta is further modified by eliminating the auxiliary electrode used for drawing ions out of the arc. Currents as high as 4·2 mA have been converged into a beam 12 mm. wide with a focusing voltage of 10 kV. When operated in hydrogen there is a preponderance of diatomic and triatomic ions with proton fractions ranging from 5 % to 20 % of the total ion current. Ions other than those of hydrogen were not present in quantities exceeding 1 %. Artificial disintegration phenomena observed by the use of this source are described and the upper and lower limits for the disintegration of heavy nuclei are given. J. E. R. C.

291. Conductivity of Compressed Metallic Vapours. W. Braunbek. *Zeits. f. Physik*, 97. 7–8. *pp.* 482–495, *Oct.* 25, 1935. *Zeits. f. techn. Physik*, 16. 11. *pp.* 497–498, 1935. *Phys. Zeits.* 36. *pp.* 891–892, *Dec.* 1, 1935.—Measurements are made to determine the electrical conductivity of Hg vapour at 35 atmospheres pressure and 730° C., and of K vapour at 10 atmospheres pressure and 1200° C. Difficulties are involved in eliminating conduction effects arising from the electronic emission and ionisation of the vapours at the high temperatures used, but it is considered that there is some metallic conduction and that at the aforementioned pressures the experiments yield upper limits of 10^{-12} ohm.$^{-1}$ cm.$^{-1}$ and 10^{-7} ohm.$^{-1}$ cm.$^{-1}$ for the metallic conductivity of Hg vapour and K vapour respectively. R. W. P.

See also Abstracts 11, 125, 168, 169, 175.

CONDUCTION IN SOLIDS AND LIQUIDS.

***292. Amplifier for Currents of the Order of Magnitude 10^{-13} A. H. Alfvén.** *Zeits. f. Physik*, 97. 11–12. *pp.* 708–717, *Nov.* 25, 1935.—In order to register the ionisation curve of a single α- or H-particle a very weak current $i(t)$ of the order of magnitude 10^{-13} A, which lasts during some hundredths of a second must be so much amplified that it can be traced by an oscillograph. Such small currents can only be amplified by letting them charge the grating capacity of an amplifying valve. The grating voltage $V(t)$ is, however, then proportional to the time integral of the current. In order to be able to record by the oscillograph the current undistorted the voltage must after amplification be differentiated as to time. An amplifier has therefore been constructed which affords a current which is proportional to the time derivative of the voltage existing at the first grating. The amplifier is an ordinary resistance-capacity amplifier, which however is provided with a short-time circuit which effects the differentiation. This apparatus amplifies the current at the first grating up to 4×10^9 times. The correctness of the amplification is good. The small distortions are theoretically and experimentally investigated. [See Abstract 152 (1936).] J. J. S.

***293. Adjustable Resistance Elements. E. F. Mueller and F. Wenner.** *Bureau of Standards, J. of Research,* 15. *pp.* 477–492, *Nov.,* 1935.—The Waidner-Wolff adjustable resistance element is used to a considerable extent in resistance-measuring apparatus and potentiometers. It serves to change the resistance of a circuit in a number of small and equal steps by means of a dial switch, at the same time reducing the effect of variations of resistance of the switch contacts and thermo-e.m.f.s in the switch. The Waidner-Wolff element, modifications of it, and another arrangement serving substantially the same purpose are considered in some detail. A 3-terminal element used in bridge circuits and a 4-terminal parallel element are also described. The adaptability of the parallel element to form useful combinations with similar or different elements is illustrated by examples. A list of the more important adjustable resistance elements now available to the designer of apparatus is included. AUTHORS.

294. Influence of Heat Conduction on Electrical Resistances with Temperature Coefficients. H. Lueder and E. Spenke. *Zeits. f. techn. Physik,* 16. 11. *pp.* 373–379, 1935. *Phys. Zeits.* 36. *pp.* 767–773, *Dec.* 1, 1935.—A universal characteristic curve is obtained between potential and current for isothermal heating. Some conductors have positive (cold-conductors) and some negative (warmth-conductors) coefficients of resistance with temperature, and the consequence is that, for the resistance with the negative coefficients, if the surface is cooled, the electric components move to the surface and the characteristic curve is bent. Similarly for the resistances with the positive coefficients the electric elements are driven to the centre and gain there is the bending of the curve. At the maximum point of the curve instability sets in and cooling of the warmth-conductor plate and the cold-conductor wire results in the piercing of the plate and the breaking of the wire. H. M. B.

295. Internal and Superficial Conductivity of Cuprous Oxide. L. Dubar. *Comptes Rendus,* 201. *pp.* 883–885, *Nov.* 12, 1935.—By comparing the conductivities of a rod and a plate of Cu_2O before and after drying over P_2O_5 it is shown that the total conductivity depends on both the internal and superficial conductivity, and that only the latter is affected by adsorbed moisture. When a dried sample is subjected to slight attack by dilute phosphoric acid, washed and dried the superficial conductivity is reduced to 1/88th of its previous value. [See Abstract 3617 (1935).] C. A. S.

296. Resistance of Rectifying Contact of Metal and Cu_2O. J. Roulleau. *Comptes Rendus*, 201. *pp*. 947–948, *Nov*. 18, 1935.—A plate of electrolytic copper is oxidised to the point of complete disappearance of the metal, and the surface layers of CuO removed with emery cloth leaving a very thin plate of Cu_2O. Electrodes in the form of narrow gold bands are then sputtered on to the plate, one at each end of one face, and one in the centre of the opposite face. The resistances between the three electrodes taken in pairs are measured with an ordinary Wheatstone bridge. If r is the resistance between the two electrodes on one face, and r_1 and r_2 those between each of these electrodes and the central one on the opposite face, then the contact resistance at the central electrode is $(r_1 + r_2 - r)/2$. The value of the high contact resistance representing rectification depends on the treatment of the surface (*e.g.*, acid treatment or grinding to remove CuO). The existence of a high contact resistance is dependent on a crystalline condition of the surface, but the dimensions of the crystals have no effect. L. H.

297. Electrical Conductivity of Cuprous Oxide. F. Waibel. *Zeits. f. techn. Physik*, 16. 11. *pp*. 366–370, 1935. *Phys. Zeits*. 36. *pp*. 760–764, *Dec*. 1, 1935.—Over a temperature range of 100 to 1000° C., equilibrium mixtures of Cu_2O and Cu were obtained and after cooling the electrical conductivity of the resulting specimen determined. A maximum in the cold conductivity of mixtures which had been heated to 400–500° C. was found, analogous to a similar maximum in the conductivity of Cu_2O in equilibrium with CuO. The results obtained are used to support a physico-chemical theory of the structure of the boundary layers in Cu_2O rectifiers. J. E. R.

298. Resistance of Very Thin Layers of Foreign Substances in Metallic Contacts. R. Holm and B. Kirschstein. *Zeits. f. techn. Physik*, 16. 11. *pp*. 488–494, 1935. *Phys. Zeits*. 36. *pp*. 882–888, *Dec*. 1, 1935.—The work of Holm and Meissner [see Abstract 3161 (1933)] on the contact resistance of 2 different conductors is extended to the case when a layer of a foreign body, a few molecules thick, is present between 2 similar conductors. It has been shown that the " specific resistance per cm^2. " is of the same order for all metals, is independent of temperature and over a range of 0·6 to 20 mV. Ohm's law applies. An explanation of these results has been offered on the basis of the electron theory of metals with the help of a formula derived by Frenkel; the assumptions made by Frenkel now appear to be invalid and an attempt is made to derive a new formula which shall give results which are in accord with experiment. Certain assumptions are made but it is found that the inaccuracy of the results deduced from this formula are not greater than the uncertainty in the values of the work functions of the conductor. H. J. H. S.

299. Electronic Configuration of Supraconducting Metals. U. Dehlinger. *Zeits. f. techn. Physik*, 16. 11. *pp*. 498–500, 1935. *Phys. Zeits*. 36. *pp*. 892–894, *Dec*. 1, 1935.—It is suggested that supraconducting elements are those for which the lattice possesses a high coordination number, not too small an atomic radius, and which have more than one electron per atom in their outer shell. Ti and other metals in this group of the periodic table are exceptions, but it is thought that their supraconductivity may be due to impurities. Supraconducting alloys appear to conform to this law. In the *Discussion* **R. Schachenmeier** referred to his wave mechanics theory of supraconductivity [see Abstract 2542 (1932)] which requires that a supraconducting metal should have at least two outer electrons. R. W. P.

300. Electrical Conductivity of Zeolites. B. Gross. *Zeits. f. Krist.* 92. *pp.* 284–292, Dec., 1935.—Zeolites are known to possess a considerable electrical conductivity [see Abstract 4228 (1933)]. Ohm's law is obeyed only for a short time. When a voltage of 3000 V/cm. is maintained the current increases. The current-voltage curves show hysteresis phenomena, both with a.c. and d.c. The behaviour is ascribed to heating effects. F. J. B.

301. Electrical Conductivity and Phase Diagram of Binary Alloys. G. Grube, L. Mohr and W. Breuning. *Zeits. f. Elektrochem.* 41. *pp.* 880–883, *Dec.,* 1935.—The phase diagram of the LiAl system is determined by thermal analysis and by temperature-resistance curves. The fluid metals are not miscible in all proportions, a miscibility gap appearing between 44·5 and 60 atomic % Li at 698° C. Conductivity measurements between normal temperature and 600° C. are employed to find the limiting concentrations of the α-solid solution on the Al side of the diagram. The existence of 2 compounds LiAl and Li_2Al is shown and their mode of formation indicated. The phase diagram shows between 0 and 30 % Li an Al-rich α-solid solution, between 30 and 50 % Li crystals of the type LiAl, between 50 and 78 % Li β-solid solution of the type LiAl with excess Li and between 78 and 100 % Li crystals of the type Li_2Al. The eutectic point is at 600° C. and 30 % Li. H. J. H. S.

302. Electrical Resistance and Reflecting Power of Evaporated Metal Films. R. Suhrmann and G. Barth. *Zeits. f. techn. Physik,* 16. 11. *pp.* 449–451, 1935. *Phys. Zeits.* 36. *pp.* 843–845, *Dec.* 1, 1935.—The resistance of films of Cu, Au, Ag, Cd, Tl and Pb deposited on silica plates at temperatures of 20°–80° K. was found to decrease as their temperature was raised to room-temperature, while at the same time the reflecting power increased. A Bi film was found to increase in resistance under the same conditions. The optical effect suggests that the observed resistance variation is probably due to an increase in the number of conduction electrons rather than to the removal of distortions in the lattice. D. H. F.

303. Wien Effect in Electrolytes Investigated with the Kathode-Ray Oscillograph. W. Hüter. *Ann. d. Physik,* 24. 3. *pp.* 253–272, *Oct.,* 1935.—A method for obtaining current-voltage characteristics for electrolytes by means of the Rogowski kathode-ray oscillograph is described and curves for solid electrolytes (Silit), weak organic acids and salt solutions obtained are shown. The examples given confirm the results obtained by Wien and his collaborators in respect to the Wien effect. The advantages and accuracy of the method are discussed. A. M. T.

304. Electrical Conductivity of Semiconductors. W. Meyer. *Zeits. f. techn. Physik,* 16. 11. *pp.* 355–361, 1935. *Phys. Zeits.* 36. *pp.* 749–754, *Dec.* 1, 1935.—It is shown that the values of the constant a in the formula $\sigma = ae^{-B/T}$, connecting conductivity and temperature of compounds, are widely scattered about the mean value. Measurements of a large number of TiO resistances, have been made, and a relation between a and the conductivity obtained. It is possible to estimate the number of bound valency electrons and therefore the number of conductivity electrons. A curve showing the relation between conductivity and electron concentration is given. J. E. R.

See also Abstracts 39, 44, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 139, 218, 311.

DIELECTRICS AND CAPACITANCE.

305. Shape and Dielectric Behaviour of Fibre-Shaped Amphoteric Ions in Solutions. W. Kuhn. *Zeits. f. phys. Chem.* 175. *Abt.A.* 1–2. *pp.* 1–16, 1935.—This paper indicates how far dielectric measurements enable conclusions to be drawn with respect to the shape of amphoteric ions [see Abstract 3463 (1934)]. The average square of the distance $\overline{r_B^2}$ between the ends of fibre-shaped amphoteric ions in solution has been calculated statistically from a consideration of the attractive forces acting between the oppositely charged ends of molecules, and is found to be nearly proportional to the chain term number Z consequent on the increase of $\overline{r_B^2}$ with increasing Z. For Z = 25, the deviation of the average square of the distance when taking into account the attraction amounts to about 40 % of that found when the attraction is neglected. The contribution of the amphoteric ions in solution to the polarisation (influence of the solution upon the dielectric constant) has been evaluated, and is the same whether the rotation of the ions or the compression-dilatation effect of the field imposed upon the ion is taken into account or not. The above circumstance that the average square of the distance when the attractive force between the ions is taken into account approximately increases linearly with the chain term number Z, is in agreement with experimental observation. From the numerical value of the proportionality factor it can be concluded that the inner field in aqueous solution for the amino-acids is essentially weaker than $4\pi\mathfrak{P}/3$. H. H. Ho.

306. Dielectric Coefficients of Volatile Compounds of Fluorine and Boron. K. L. Ramaswamy. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 364–377, *Oct.*, 1935.—The dielectric coefficients of CF_4, NF_3, CHF_3, $(CF_3N)_2$, B_2H_6 and $B_3N_3H_6$ (in the vapour state) are measured at different temperatures to obtain the values of their electric moments. These values are 0, 0·21, 1·59, 0·46, 0 and $0{\cdot}67 \times 10^{-18}$ respectively. Accurate measurements of compressibilities at the ordinary temperature by refractometric studies and approximate values at low temperatures by studying variations of dielectric coefficients, are made. The significance of the moments is briefly discussed. AUTHOR.

307. Densities and Molecular Polarisations of Menthol and Borneol. H. Harms. *Zeits. f. phys. Chem.* 30. *Abt.B.* 5–6. *pp.* 440–442, 1935.—Densities of *l*-borneol and *l*-menthol in benzene have been determined at different concentrations of solute. Molecular polarisations from dielectric constant measurements are given and the deduced dipole moments are 1·65 and 1·62 Debye units respectively. W. R. A.

308. Relaxation Time of Polar Liquids including Saturation Effect. S. Oka. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 362–368, *Sept.*, 1935. *In German.*—A mathematical paper in which the author integrates the partial differential equation for the distribution function (f) of the electric moment μ after application of an electric field E_0, *viz.*—

$$\zeta \cdot \delta f/\delta t = (k\mathrm{T}/\sin\theta) \cdot \delta/\delta\theta (\sin\theta \cdot \delta f/\delta\theta)$$

where ζ is the internal friction constant, k the Boltzmann constant, and T the absolute temperature. The general solution which satisfies the initial condition $(f)_{t=0} = \mathrm{A}e^{(\mu\mathrm{E}_0/k\mathrm{T})\cos\theta}$ is $f = \sum_{n=0}^{\infty} \mathrm{A}_n e^{-\{n(n+1)/2\}t/\tau} \mathrm{P}_n \cos\theta$ where $\tau = \zeta/2k\mathrm{T}$, and $\mathrm{A}_n = \mathrm{A}\sqrt{(\pi/2a)}\,(2n+1)\mathrm{I}_{n+\frac{1}{2}}(a)$, $a = \mu\mathrm{E}_0/2k\mathrm{T}$ and $\mathrm{I}_{n+\frac{1}{2}}$ is a modified Bessel function of the first type of order $n + \frac{1}{2}$. The mean moments for $a \gg 1$ and $a \ll 1$ are also calculated. A. M. T.

309. Field Strength and Frequency Dependence of the Dielectric Constants of Anisotropic Liquids. W. Kast. *Zeits. f. techn. Physik*, **16. 11.** *pp.* **475–479, 1935.** *Phys. Zeits.* **36.** *pp.* 869–873, *Dec.* 1, 1935.—The decline of the dielectric constant with increasing field strength in the case of anisotropic liquids, slackens appreciably at about 1000 V/cm. although the dielectric constant is still considerably above the optical value. Only a part, however, of the orientation polarisation is accounted for, namely that which corresponds to the average moment of the large molecular groups, while the single dipole molecules within the groups possess adequate mobility since they still contribute an orientation effect to the polarisation. Generally it must be concluded from the existence of such stages in the decline of the dielectric constant with increasing field strength, as well as with increasing frequency that there is present an essentially unitary degree of association. H. H. Ho.

310. Dielectric Loss Characteristics of a Chlorinated Diphenyl. W. Jackson. *Roy. Soc., Proc.* 153*A*. *pp.* 158–166, *Dec.* 2, 1935.—The paper describes a series of power factor measurements on a chlorinated diphenyl over the frequency range 50 to $10^7 \sim$ and at temperatures from $-15°$ to $+80°$ C. The results are discussed in terms of the Debye theory and related to the chemical constitution of the material. It has frequently been doubted whether the necessary physical conditions for the appearance of a Debye power factor maximum at frequencies as low as 50 $\sim$ can arise at normal temperatures. Since it has been possible with this material to follow the maximum through the above frequency range within the temperature span -5 to $+40°$ C., and relate this behaviour to the variation of the measured viscosity coefficient, this doubt can no longer be maintained. AUTHOR.

311. Electrical Investigation of Solutions of Stearanilide in Paraffin Wax. W. Jackson and F. C. Frank. *Faraday Soc., Trans.* 31. *pp.* 1700–1706, *Dec.*, 1935.—Studies of dielectric loss and d.c. conductivity in dilute solutions of stearanilide in molten and solid paraffin wax give results which can only be interpreted by the presence in solution of polar groups of about ten (possibly more) stearanilide molecules each. It is suggested that the molecules in the group may approach a liquid crystalline arrangement. The groups also appear capable of absorbing ionised impurities in the system. AUTHORS.

See also Abstracts 56, 57, 190.

ELECTROCHEMISTRY.

312. Potentials of Cells in Liquid Ammonia Solutions. Thermodynamic Constants of the Ammino Cadmium Chlorides and of Cadmium Chloride. C. S. Garner, E. W. Green and D. M. Yost. *Am. Chem. Soc., J.* 57. *pp.* 2055–2058, *Nov.*, 1935.—In liquid NH_3 solutions of NH_4Cl at 25° the potentials of the cell Zn (amalg., N_2), $ZnCl_2 \cdot 6NH_3(s)$, $NH_4Cl(\text{in } NH_3(l))$, *f.*, $CdCl_2 \cdot 6NH_3(s)$, Cd(amalg., N_1) are measured at several concentrations of the dissolved substances. The cell gives accurately reproducible and reversible e.m.f.s. When zinc and cadmium are present as pure metals $E^0_{298.2} = 0{\cdot}3605$ volt. From the e.m.f. and the temperature coefficient of the cell, together with the results of other investigators, the standard free energies, heat contents and virtual entropies of the solid ammino cadmium chlorides and cadmium chloride are calculated. Provisional values for the activity coefficients of NH_4Cl in liquid NH_3 at 25° are calculated and the results, combined with free energy data, are used to evaluate the standard electrode potentials of three known half-cells with reference to the standard H electrode in liquid NH_3. AUTHORS.

313. Purification of Water and its pH Value. S. B. Ellis and S. J. Kiehl. *Am. Chem. Soc., J.* 57. *pp.* 2145–2149, *Nov.*, 1935.—Methods for the purification of water are investigated and important information concerning this general problem is obtained. The pH value of the purest water, collected in silver vessels, is measured directly by means of the glass electrode and found to be 7·01 at 27·5°. AUTHORS.

314. Electrolysis of Copper into Rock Salt. S. Arzybyšev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 4. *pp.* 157–160, 1935. *In German.*—A correction. [See Abstract 864 (1935).] F. J. B.

315. Hardness of Electrolytic Chromium. S. P. Makariewa and N. D. Birükoff. *Zeits. f. Elektrochem.* 41. *pp.* 838–842, *Dec.*, 1935.—The first part of this paper [see Abstract 4370 (1935)] referred to the independence of the hardness of electrolytic chromium on the quantity of H_2 which the metal contains. The present paper records the results of an inquiry into the influence of the current density and temperature of electrolyte on Cr electrolysis. In investigating temperature influence on Cr deposit it is established that the solubility of H_2 in Cr rises with temperature of electrolyte to 35° C., sinking slightly from 35° C. to 40° C., then further strongly rising. The hardness curves of Cr and the H_2 solubility curves run in opposite senses to 30° C., though from 30° C. to 40° C. they run in the same sense. This latter circumstance suggests the dependence of both the H_2 solubility and the hardness on a third factor. As such, the grain size of the deposit and obviously the constitution of the hexagonal lattices are conceived as affecting the structure of the deposit. After driving out the H_2 the hardness curves of the various deposits remain unchanged which is also proof that the hardness of the Cr does not depend on the presence of H_2. J. E. B.

316. Ionic Mobility. J. J. Hermans. *Zeits. f. Physik*, 97. 11–12. *pp.* 681–689, *Nov.* 25, 1935.—The Born effect on ionic mobility is accurately calculated, on the basis of the theory that the motion of the ion is retarded by the dipole of the solvent. Equations are developed for the case of infinite dilution, and extended to the case of other dilution. The dependence upon concentration is, as a first approximation, proportional to the concentration and not to the square root of the concentration.

F. J. B.

317. Activity of Chlorine Ions in Solutions of Complex Chlorides of Cobalt and Chromium. M. Châtelet and F. Kertész. *Comptes Rendus*, 201. *pp.* 817–819, *Nov.* 4, 1935.—The potential of the AgCl electrode in the cell $Ag \mid AgCl,\ X,\ gelose \mid Hg_2Cl_2\ satd. \mid Hg$ is determined with $X = KCl$, $BaCl_2$, $[Co(NH_3)_5Cl]Cl_2$ (I), $[Co(NH_3)_5 \cdot H_2O]Cl_3$ (II), and $[Cr(NH_3)_5Cl]Cl_2$ (III). Results with I, II and KCl are very similar *inter se*, as are those with III and $BaCl_2$. This implies that I and II apparently have only one ionisable Cl; while III, especially in solutions of concentration $< 0{\cdot}0005$-M, has two as usually formulated. C. A. S.

318. Electrometric Control of Displacement Reactions. Suzanne Veil. *Comptes Rendus*, 201. *pp.* 885–887, *Nov.* 12, 1935. When electrodes of Pt and Zn, previously connected to an electrometer, are inserted, the Pt first, in solution of $CuSO_4$ (*e.g.*, 0·2 *N*), the e.m.f. first measured on inserting the Zn (1·19 V) decreases to a minimum of 0·98 V after about 0·5 hr., rises to 1·16 V after 2 hr., remains stationary for 1 hr. and then becomes irregular. The results are interpreted to imply that the chemical is merely accessory to the Volta effect, and that the initial decrease in e.m.f. is a secondary Volta effect due to replacement of the Zn surface of the kathode by one of Cu [see Abstract 5197 (1935)]. C. A. S.

319. Application of the Glass Electrode to Unbuffered Systems. S. B. Ellis and S. J. Kiehl. *Am. Chem. Soc., J.* 57. *pp.* 2139–2144, *Nov.,* 1935.—The practical measurement of pH in the most difficult of unbuffered aqueous systems is accomplished by means of the glass electrode. General technique is developed, and examples are given. AUTHORS.

320. Organic Depolarisers. W. H. Hunter and L. F. Stone. *J. Phys. Chem.* 39. *pp.* 1139–1147, *Nov.,* 1935.—The single potentials of a number of organic depolarisers are measured against kathodes of different metals. A theory is put forward which introduces the idea of the work function of an electrode. Electrons are removed from the electrode by the depolariser and the magnitude of the increased positiveness will depend on the work required to remove electrons from that kathode, *i.e.*, upon the work function under the conditions of the experiment. The " electron affinity " of depolarisers is defined and a new idea of " overvoltage " developed. C. J. B. C.

321. Hydrogen Peroxide Theory of Electrolytic Oxidation and the Influence of the Electrode Surface on Anodic Processes. S. Glasstone and A. Hickling. *Faraday Soc., Trans.* 31. *pp.* 1656–1660, *Dec.,* 1935.—Anodic overvoltages are determined at smooth Pt, platinised Pt, untreated and treated in various ways, Au, MnO_2 and PbO_2, arc gas-carbon and Ni electrodes. The results show that overvoltages cannot be correlated in any simple manner with the efficiencies in the oxidation of acetate, thiosulphate and sulphite ions. Some difficulties of the discharged-ion theory of anodic processes are pointed out, and it is shown that the formation of H_2O_2 in solution by the union of hydroxyl radicals is not improbable. It is emphasised that no one mechanism is likely to account for all the various types of anodic oxidation reactions. [See Abstract 3996 (1935).] AUTHORS.

See also Abstracts 28, 217, 303.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

322. Creation of Electrons and Positrons by Heavy Charged Particles. Y. Nishina, S. Tomonaga and M. Kobayasi. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 584. *pp.* 137–177, *Aug.,* 1935. *In English.*—In an entirely mathematical paper the authors calculate the cross-sections for the creation of electron pairs by fast charged particles on colliding with atomic nuclei. It is claimed that the calculations are accurate when a heavy incident particle is in collision with a still heavier nucleus which does not move appreciably during the collision. For Pb the value of the cross-section obtained is $5 \cdot 6 \times 10^{-25}$ cm^2. for 10^8 eV electrons and $3 \cdot 5 \times 10^{-25}$ cm^2. for 10^{11} eV protons. This is about 70 times smaller than the cross-section for the creation of pairs by photons of energy 10^9 eV and 300 times smaller than for photons of energy 10^{11} eV. The results are modified if the screening effect of the outer electrons is taken into account. Omitting the close collisions for which the calculations are doubtful a theoretical lower limit for the cross-section is obtained. This is about 7×10^{-24} cm^2. for lead when the energy of the incident particle is greater than 10^{13} eV in the case of electrons or 10^{15} eV in the case of protons. J. E. R. C.

323. Electron Energy Losses and Effective Cross-Sections of Gas Molecules. H. Löhner. *Ann. d. Physik*, 24. 4. *pp.* 349–360, *Oct.*, 1935.—Using a modification of the Lenard retarding potential method described in a previous paper [see Abstract 1772 (1935)] the energy losses of very slow electrons in H_2, N_2, NO, CO, N_2O and CO_2 are measured. Inelastic collisions are found at the following velocities: in H_2 at 4·25, in N_2 at 2·45, in CO at 2·4, in NO at 3·65, in N_2O at 7·2, and in CO_2 at 7·1 V. In each case these are the smallest losses observed, and a table is given showing higher losses for each gas. The molecular cross-section for inelastic impacts can be obtained from results previously given by Kollath by subtracting the " elastic " cross-section from the total cross-section. The relationship between the energy losses obtained and the " inelastic " cross-sections of the molecules is discussed in detail. J. E. R.

324. Effective and Discharge Diameters of He and He⁺. A. Rostagni. *Ann. d. Physik*, 24. 6. *pp.* 543–544, *Nov.*, 1935.—Two recent papers on this subject by F. Wolf [see Abstract 4705 (1935)] are criticised because the discharge diameter is larger than the total effective diameter. The author describes the results of measurements he has made on the scattering and total effective diameter of A^+, Ne^+ and He^+; he claims that his method is of greater sensitivity than that of Wolf. His values of effective diameter agree with those of Wolf but his values of discharge diameter are about 50 % smaller. Reasons are suggested for the discrepancies and a number of factors overlooked by Wolf are pointed out. H. J. H. S.

325. Charge Potential and Secondary Emission from Bodies Irradiated by Electrons. M. Knoll. *Zeits. f. techn. Physik*, 16. 11. *pp.* 467–475, 1935. *Phys. Zeits.* 36. *pp.* 861–869, *Dec.* 1, 1935.—The relation between charge potential and the velocity of the primary electrons incident on a metal plate in a high vacuum shows a discontinuity in the range 0–5000 V. For C the charge potential is directly proportional to the primary electron velocity. An explanation is offered by reference to the secondary emission curves. An experimental method is described for obtaining a sharp image of the secondary electron distribution on a metal surface using a modified kathode-ray oscillograph; such images show good contrast for plate potentials which are negative with respect to the anode, but with increasing positive potentials, the contrast falls off until at + 15 V the image completely disappears. For high positive potentials (up to about 1000 V) a weak reversed image appears; this seems to be due to reflected primary electrons. The results of experiments on the secondary electron distribution on metallic crystals, the dependence of the secondary emission on the angle of incidence of the primary electrons and the effects of secondary space charges are described. A method is devised for studying the distribution of secondary emission and charge on the inner surfaces (conductors and insulators) of an electron tube. H. J. H. S.

See also Abstracts **22**, **23**, **55**, **303**.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

326. Nickel-Manganese System. Part II. S. Valentiner. *Zeits. f. Physik*, 97. 11–12. *pp.* 745–757, *Nov.* 25, 1935.—The relation between the alteration in resistance in a magnetic field of a number of Ni-Mn alloys and the thermal treatment is given graphically, as well as the variation of resistance with field. Alloys containing up to 20 % Mn appear normal but those with 25 and 30 % Mn show fairly large negative values for the alteration with field. [For Part I see Abstract 1930 (1935).] H. J. H. S.

327. Longitudinal Resistance Change in Magnetic Field. A. Sommerfeld and B. W. Bartlett. *Zeits. f. techn. Physik*, 16. 11. *p.* 500, 1935. *Phys. Zeits.* 36. *pp.* 894–899, *Dec.* 1, 1935.—Reference is made to the manner in which the comparatively elementary electronic theory of Sommerfeld based on the Fermi statistics was successful in explaining many problems. For the change of resistance in a transverse magnetic field, however, it gave too small a value and indicated no change in a longitudinal field, whereas experience shows the change to be of the same order under each condition. It is now realised that the discrepancy in the longitudinal case rests on the omission of the quantisation of the electron orbits, and that when allowance is made for this the elementary theory no longer leads to zero change, but gives a result in agreement with the recent theory of Titeica [see Abstract 1852 (1935)]. R. W. P.

MAGNETISM AND ELECTROMAGNETISM.

328. Calculation of Vector-Potential Fields. T. Schlomka. *Zeits. f. techn. Physik*, 16. 11. *pp.* 479–481, 1935. *Phys. Zeits.* 36. *pp.* 873–875, *Dec.* 1, 1935.—A general method for calculating the vector potential of an electromagnetic field is worked out and applied to the determination of the field of a solenoid. G. C. McV.

329. Separation of Magnetic Viscosity and Eddy-Current Lag. A. V. Mitkevitch. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 5. *pp.* 209–211, 1935. *In English.*—The difficulty in separating magnetic viscosity and eddy-current lag lies in the uncertainty in calculating the latter. The difficulty may be overcome by imposing certain conditions, *e.g.*, when $H = 0$ after removal of a magnetising force H_m which has acted for a definite time. A method is described by which measurements may be made of the magnetic viscosity and eddy-current lag separately. [See Abstract 5241 (1934).] H. J. H. S.

330. Temperature Dependence of Free Electron Susceptibility. E. C. Stoner. *Roy. Soc., Proc.* 152*A*. *pp.* 672–692, *Nov.* 15, 1935.—Various formulæ which are required by Fermi-Dirac statistics for the calculation of magnetisation are given. Calculations are made of the magnetisation as a function of H and T for the spin and diamagnetic effects separately and for the resultant effect at low and high temperatures. Two formulæ are derived for the cases where ϵ_0 (the maximum electron kinetic energy in the completely degenerate state) is $\gg kT$ and $\ll kT$. Niessen's treatment is criticised. The experimental results for metals are considered, and the increase in the susceptibility of the alkali metals may be due to the change in ϵ_0 associated with thermal expansion. W. R. A.

331. Ionic Diamagnetism in the Solid State and in Solutions. H. Fahlenbrach. *Ann. d. Physik*, 24. 5. *pp.* 485–488, *Nov.*, 1935.—The work of Frivold and his collaborators is criticised; water, being a polymerised solvent, does affect the diamagnetism of dissolved salts. W. R. A.

332. Paramagnetism. Part III. Light Absorption in Paramagnetic Crystals and Solutions. S. Datta and M. Deb. *Phil. Mag.* 20. *pp.* 1121–1136, *Dec.*, 1935.—The influence of temperature and solvent on the absorption spectra of the chlorides of Cr, Co and Ni is investigated. Spectra for anhydrous and hydrated Co and Ni chlorides are obtained.

The results are discussed in relation to a theory which has been developed to explain the characteristics of the optical absorption of an ion of the transition group which forms part of either a complex ion or of an undissociated molecule. Conclusions similar to those drawn from the magnetic behaviour can be drawn from the spectra regarding the nature of different types of interactions with surrounding ions, atoms, and molecules. [For Part II see Abstract 3930 (1934).] W. R. A.

333. Difficulty of the Existence of Infinite Energy of Radiation at Absolute Zero in Quantum Electrodynamics. B. Kwal. *Comptes Rendus*, 201. *pp.* 776–778, *Oct.* 28, 1935.—It is proposed to meet the difficulty by replacing the canonical transformation which brings the number of photons in the field into correspondence with the field amplitude by a more symmetrical transformation whereby the classical product of the type AB is replaced by the symmetrical expression $1/2(AB + BA)$. These relations envisage the appearance of demi-photons. [See Abstract 3663 (1935).] N. M. B.

334. Magnetostriction Volume Effect in Nickel and Magnetite. M. Kornetzki. *Zeits. f. Physik*, 97. 9–10. *pp.* 662–666, *Nov.* 12, 1935.—Curves are given of the volume magnetostriction effect for Ni and magnetite. For the former a volume decrease is found in small fields but at fields above saturation point (about 400 G.) a linear increase with field is noticed (2×10^{-10}/G.). This increase is not in agreement with previous measurements on thermal expansion. Magnetite shows a linear decrease in volume at high fields (-7×10^{-11}/G.). H. J. H. S.

***335. Theory of the Grassot Fluxmeter. J. Surugue.** *J. de Physique et le Radium*, 6. *pp.* 486–488, *Nov.*, 1935.—A mathematical paper giving the calculations for obtaining the corrections to be applied to the readings of a suspension-type instrument, and taking into account the torsion couple. N. M. B.

***336. Determination of Hysteresis with Fahy Simplex Permeameter. R. L. Sanford and E. G. Bennett.** *Bureau of Standards, J. of Research*, 15. *pp.* 517–522, *Nov.*, 1935.—An attachment for the Fahy simplex permeameter is described by which the H-coil can be quickly rotated end for end. By means of this attachment values of the magnetising force H, corresponding to points on a hysteresis loop, can be attained with as high precision as was only possible previously for points on the normal induction curve, and smoother curves are obtained in less time than can be done with the original arrangement. AUTHORS.

See also Abstracts 20, 44, 134.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***337. Electrical Impedance of the Human Body. J. W. Horton and A. C. van Ravenswaay.** *Frank. Inst., J.* 220. *pp.* 557–572, *Nov.*, 1935.—A survey of published experimental work on the subject, followed by the authors' analysis and a description of their experimental work leading to the development of a technique for the measurement of the impedance of living tissues, the internal impedance and the sheath impedance being separately evaluated. D.c. measurements are unsuitable due to polarisation and the method evolved includes an a.c. potentiometer and a 4-electrode arrangement to measure p.d. due to resistance and reactance. In the apparatus as finally built for the purpose the variable mutual inductance is directly calibrated in ohms reactance at the designed frequency of 10 kc, the detector being an external amplifier and a rectifier instrument for visual indication. The apparatus has been in use for some time at the Massachusetts General Hospital. E. H. W. B.

338. H.F. Conductivity of Blood. F. Graul. *Ann. d. Physik*, **24.** 4. *pp.* 326–348, *Oct.*, 1935.—The h.f. conductivity of three kinds of blood (ox, pig, human) is found to be independent of the wave-length in the region 6–20 m. For wave-lengths between 20 m. and 25 m. the conductivity of centrifuged blood decreases as the wave-length increases. The dependence of the conductivity on the time of centrifuging, the l.f. conductivity and the viscosity is investigated for a wave-length of 13·6 m. The results are discussed in connection with Dänzer's theory and are combined with the results of other observers for currents of frequencies outside the range of those used by the author. W. E. P.

339. Physiological Considerations of Sources of Ultra-Violet Radiation. Dognon and E. and H. Biancani. *Soc. Franç. Élect., Bull.* 5. *pp.* 1067–1077; *Disc.*, 1077–1082, *Oct.*, 1935.—The spectral distribution of the radiation from various sources is discussed, and it is shown that an ordinary lamp gives little radiation below 300 $m\mu$, a " sunlamp " with uviol glass gives radiation above 200 $m\mu$, and electronic lamps having argon and neon at low pressures have a spectrum extending to 250 $m\mu$. The biological actions of the various lamps are also discussed from the points of view of (1) bactericidal action, (2) erythemal effects, and (3) anti-rachitic action. With regard to (1) and (2) the mercury-vapour lamp is shown to be the most efficient. It is concluded that the " sunlamp " has valuable properties, and that for some purposes there may be advantages in filtering out short wave-lengths from other spectra. G. E. B.

***340. High-Powered Mobile X-Ray Unit. H. T. Ferrier.** *Radiography*, 1. *pp.* 122–131; *Disc.*, 131–132, *Oct.*, 1935.—A further description [see Abstract 3942 (1934)] of a mobile X-ray unit used by the Red Cross Society. Details of the methods used to maintain steady operating conditions are given. G. E. B.

***341. Progress in Design of Shock-Proof X-Ray Tubes for Therapy and Industrial Roentgenography. M. J. Gross.** *Am. J. of Roentgenology and Radium Therapy*, 34. *pp.* 518–522, *Oct.*, 1935.—A communication from the works of the General Electric X-Ray Corporation relating to the general principles of construction of shock-proof X-ray apparatus, as now generally employed. Briefly discussed are the construction of modern X-ray tubes to render the centre of the tube at earth potential, the advantages of oil-cooling over water-cooling of the anode, and the cable which is employed and the construction of the earthed tube container, which has protection against general X-ray emission at its centre only. Also briefly and chiefly by illustration, the application of such an X-ray unit to industrial purposes to examine welds, as well as to medical purposes, is mentioned. B. J. L.

***342. Methods of Enhancing X-Ray Action. A. J. Delario.** *Radiology*, 25. *pp.* 617–627, *Nov.*, 1935.—The author investigates the treatment of malignant conditions by use of h.f. currents of 30 to 50 × 10^6 ∼, particularly in respect to the Flexner-Jobling rat tumour. After briefly discussing the recognised variation of different tissues to X-rays and the possibility of natural or induced fever affecting the retrogression of tumourous tissues, a comprehensive review of other work in short-wave therapy is given. The apparatus is briefly described. To evaluate the action of radiothermy, in conjunction with X-rays, it is first necessary to investigate the action of X-rays alone. In this case no very definite alteration of temperature occurs. When applying both radiothermy and X-rays, temperature increase results, with increased mortality, but greater disappearance of the tumours generally. A new method of treating tumours is proposed in which steel needles are inserted at the periphery of a growing tumour, the needles being heated by radiothermic induction, so causing tissue necrosis. The possibility of this method replacing the common use of radium needles is suggested. Increase of the effect of X-rays by secondary radiators is also suggested. B. J. L.

343. Distribution of Radiation in Deep X-Ray Therapy. H. M. Parker and Joan Honeyburne. *Brit. J. of Radiology*, 8. *pp.* 684–696, *Nov.*, 1935.—Depth-dose tables for X-rays at 200–250 kV, filter 1 mm. Cu + 1 mm. Al, for target-skin distances of 40, 60, 80 and 100 cm. have been obtained for rectangular and circular apertures. Complete isodose curves in the principal planes are given for target-skin distance 40 cm. at 200 kV, with some examples at 200 kV (80 cm.) and 250 kV (40 cm.). The distribution at right angles to the principal planes is also indicated. The chief effect of increasing the tube voltage from 200 to 250 kV is to sharpen the definition of the beam in the tissues. Four different ionisation measuring instruments were used, the larger ionisation chambers giving rather higher readings at all depths. Extrapolation to zero chamber size gave dosage rates almost identical with those found with the smallest chamber, thus enabling readings to be reduced effectively to point measurements. J. E. R.

344. Action of X-Rays upon the Lactate, Glucose Citrate and Succinate Dehydrogenases. R. E. Havard. *Brit. J. of Radiology*, 8. *pp.* 787–791, *Dec.*, 1935.—It is shown that 20,000 *r* of mixed X-rays have no effect upon the activities of preparations of lactose, glucose and citrate dehydrogenases. It is shown that a similar dose of γ-rays slightly inhibits the activity of a preparation of succinate dehydrogenase. It is concluded that the biological effects of X-rays are in all probability not caused by a primary action upon the enzymes of respiration. AUTHOR.

345. Intensity Distribution of Radium Radiation. L. G. Grimmett and J. Read. *Brit. J. of Radiology*, 8. *pp.* 702–713, *Nov.*, 1935.—The intensity distribution in water of the radiation from 3 gm. and 4·9 gm. units is measured by Sievert's condenser chamber method, using an elektron metal chamber. Contours showing the intensity values in röntgens per hour under different conditions are given. The results of different observers' measurements of the output in "*r*" per hour from 1 mg. radium at 1 cm. are reviewed and the authors' measurements of this quantity for various filtrations up to 15·9 mm. Pb are described. W. E. P.

See also Abstract 201.

OSCILLATIONS.

346. Space Charges and Electron Oscillations in Magnetron Triodes. H. A. Schwarzenbach. *Helv. Phys. Acta*, 8. 7. *pp.* 565–586, 1935. *In German.*—A triode with cylindrical electrode system is subjected to a coaxial magnetic field and the effect of such a field is investigated. Particular attention is given to the relation between grid current and magnetic field and it is found that below a certain critical value of the magnetic field a new type of space-charge effect is exhibited. Further, it is found that the known maximum in the curve connecting grid current with magnetic field is a pure space-charge effect and does not occur when the triode is accurately adjusted in the magnetic field. This gives a simple electrical method for accurate setting of the triode. Finally an investigation is made of the transfer from the space-charge-free condition to that of stable space charges with electron oscillations. [See also Abstract 2235 (1934).] A. W.

See also Abstract 292.

PHOTOELECTRICITY.

347. Energy Distribution of Electrons in the Photoelectric Effect. E. Rudberg. *Phys. Rev.* 48. *pp.* 811–817, *Nov.* 15, 1935.—The character of the photoelectric emission from a metal depends on the distribution of electron levels, the transition probabilities from these levels and the extent to which the levels are populated by electrons. The last of these is given by the Fermi factor. Various expressions have been suggested for the first two. These are discussed, and equations for the energy distribution derived in each case. The results are compared with experimental data for molybdenum, published by Roehr. In all cases the proportion of low energy electrons predicted appears to be too high. The theory of Mitchell comes nearest to fitting the experimental data over the low energy range. The stopping potential currents for higher energy, when plotted on a logarithmic scale as done by Roehr, fall nicely on the curve calculated on the theory of Mitchell. It is pointed out that the agreement obtained with such logarithmic plots is essentially a check on the dominating Fermi factor, and that the region of low energies in the energy distribution, for which the Fermi factor is practically unity, is the important one for studies of the electronic structure of metals. AUTHOR.

348. Photo-Resistance of Metals. Q. Majorana. *N. Cimento,* 12. *pp.* 409–417, *July,* 1935.—An account is given of further investigations of the metallic photo-resistance found by the author [see Abstract 857 (1934)]. After reference to facts which distinguish it from a pure thermal action of light on the resistance of metals, new determinations of the phase lag ϕ between pulsating light acting on the metallic lamina and the resistance of the latter are described. It is found that for metallic laminæ fixed on glass ϕ amounts to about 45°, but may in exceptional cases be as low as 16°; whilst for laminæ free in air it may be very nearly 90°, but sometimes only 65°. Moreover ϕ increases on decrease of the frequency of the light, and this variation is strongest for light from a mercury lamp. The results confirm the supposition of the existence of a new photoelectric effect that, in contrast with the ordinary photoelectric effect, is in its nature rather *slow* in its manifestation. J. J. S.

349. Photo-Effect in Thin Adsorbed Layers of Alkali Metals. W. Gei and I. Truten. *Phys. Zeits. d. Sowjetunion,* 8. 3. *pp.* 342–351, 1935. *In German.*—Layers of the thickness of a few atomic diameters are obtained through adsorption of vapours of alkali metals in well dried silica gel. These layers exhibit an electrical conductivity which obeys Ohm's law, and show a photo-effect. The red boundary of the photo-effect for such layers is situated for K at 7800 Å and for Cs at 9550 Å. The photo-current curves obtained from measurements on the layers have a normal course and have no selective maxima. J. J. S.

350. Atomic Films of Alkali Metals on Platinum. H. Mayer. *Zeits. f. techn. Physik,* 16. 11. *pp.* 451–454, 1935. *Phys. Zeits.* 36. *pp.* 845–848, *Dec.* 1, 1935.—A method of deposition of atomic films of alkali metals on Pt is described, the apparatus being so designed as to allow the thickness of the film to be determined from a knowledge of the concentration of the atomic beam from the evaporating metal. The photoelectric output of a film of K on Pt was determined for various film thicknesses. For outgassed Pt and K the output increases rapidly with thickness until the film is approximately monatomic, after which it increases slowly; if the metals are not outgassed there is a maximum of emission for an approximately monatomic film. D. H. F.

***351. H.F. Characteristics of Gasfilled Photo-Cells. A. Roggendorf.** *Phys. Zeits.* 36. *pp.* 660–673, *Oct.* 15, 1935.—A periodic light intensity of frequency variable between 20 and 300 kc. is produced by passing a beam through a Kerr cell excited by a h.f. oscillator, details of which are given. Details of the construction and testing of the amplifier used with the photo-cells are also given. The photo-cell response falls steadily with increasing frequency until a certain frequency, which varies between 70 and 140 kc. for different types of cells, is reached, after which it remains constant up to 300 kc., the limit of measurements. The response is then equivalent to that of a vacuum cell of the same type. The theoretical prediction [see Abstract 1231 (1933)] that the falling characteristic should have a wave form is shown to be unjustifiable for all commercial photo-cells. D. H. F.

***352. Time-Lag of Gasfilled Photo-Cells. I. Kvartskhava and P. Timofeev.** *Techn. Phys., U.S.S.R.* 1. 4. *pp.* 469–478, 1935. *In English.*—The relation between the time-lag of a gasfilled photo-cell and the constant determining the discharge condition in the cell is dealt with. It is shown that the time-lag is due to the finite time required for the flight of the positive ions between the electrodes. It is pointed out that the current of a non-self-maintaining discharge does not attain its minimum steady value after a time τ from the moment of the illumination of the kathode, but grows gradually owing to the increasing volume of each electron group compared with the preceding one, so that the stationary state can be considered to be attained only after the passage of a certain number n of groups of electrons and ions between the electrodes. Thus the period of oscillation of the light intensity at which time-lag appears is proportional to n and to τ. This agrees with the experimental results obtained by the authors. J. J. S.

***353. Limits of Effectiveness of Selenium Cells with Blocking-Layers. H. König.** *Helv. Phys. Acta*, 8. 6. *pp.* 505–507, 1935. *In German.*—Results show, that in no region of intensity do laws of proportion and supposition hold for these cells, the deviation from proportionality being least in the blue region of the spectrum. In using these cells it is recommended that large jumps in intensity be avoided. There are enumerated five uses to which these cells may be put, with the percentage accuracy obtainable in each case. Two such uses are the comparison of lights of different colours [see Abstract 2520 (1935)] and the measurement of the intensity of the light transmitted by coloured glass. H. M. B.

***354. Absolute Calibration of Photo-Cells. H. Theissing.** *Phys. Zeits.* 36. *pp.* 683–684, *Nov.* 1, 1935.—A method is described for determining the constant of proportionality for the conversion to absolute values of the observed values for the relative response of a photo-cell at different wave-lengths to an equal-energy spectrum. The method entails a single measurement of the response of the photo-cell to the undispersed light from a source whose spectral emission characteristics are absolutely known. An example is given. D. H. F.

355. Theory of Photoelectric and Photomagneto-Electric Phenomena in Semiconductors. J. Frenkel. *Phys. Zeits. d. Sowjetunion,* 8. 2. *pp.* 185–203, 1935. *In English.*—The general equations for the number of free electrons and positrons in an intrinsic semi-conductor are derived under the assumption of a linear symmetrical law for the rate of their trapping as a function of the concentration. These equations are applied to the Dember effect, and to the Kikoin-Noskov photomagneto-electric effect. D. H. F.

See also Abstracts 167, 168, 169.

THERMIONICS.

356. Positive and Negative Thermionic Emission from Molybdenum. H. B. Wahlin and J. A. Reynolds. *Phys. Rev.* 48. *pp.* 751–754, *Nov.* 1, 1935.—The positive and negative thermionic emission for Mo is investigated. The electron work function is found to be 4·17 V and that of the positive ion 8·35 V. The positive ion emission is shown to agree with the Saha theory of ion formation to within the experimental limits of error. AUTHORS.

357. Disintegration of Monatomic Layer of Thorium on a Tungsten Kathode in a Mercury Discharge. N. Morgulis and M. Bernadiner. *Techn. Phys., U.S.S.R.* 2. 4. *pp.* 333-352, 1935. *In English.*—Experiments are carried out in specially designed tubes on the disintegration of a monatomic Th film on a W filament bombarded by positive Hg-ions from a gaseous discharge. The tubes have cylindrical anodes and two filaments, one of which is thoriated, whilst the other, of pure W, is used to produce an additional discharge which serves as a source of ions with which to bombard the thoriated surface. With the ordinary two-electrode system, similar to that of Hull, the W filament being switched off, the magnitude of the critical energy is found to vary with the temperature of the thoriated kathode in a manner which can be explained by means of the Th balance equations. When the thoriated filament is held at a sufficiently low temperature (1600°–1700° K) and is bombarded by ions from the additional discharge, the results obtained indicate that with increase of the bombarding ion current the magnitude of the critical energy decreases, reaching gradually some limiting value of the order of 13-18 V. The probability of disintegration is found to increase rapidly with increase in the ion energy. The experimental confirmation of the existence of the critical energy necessitates additional theoretical analysis of the condition of disintegration. Such analysis leads to the condition $V_k \gg \{L - (1 - \beta)V_h\}/\alpha\,(1 - \beta)$ as governing an elementary disintegration process, and to the following equation for V_o the critical energy, $V_o = \{L - (1 - \beta)V_h\}/\alpha(1 - \beta)$. V_h is the neutralising energy of the impinging ion, α its accommodation coefficient, L the energy of evaporation of the surface atom and β the portion of its energy lost at impact with the next atom. The equation for the critical energy is satisfactorily confirmed by the experimental results. A. W.

***See also* Abstract 346.**